Official Organ of the American Welding Society

The Welding Engineer

Edited by L. B. Mackenzie

$3.00 per year in U. S. | Reg. U. S. Pat. Office | $4.00 per year abroad

Vol. 5 | Chicago 608 S. Dearborn St | DECEMBER, 1920 | New York 171 Madison Ave. | No. 12

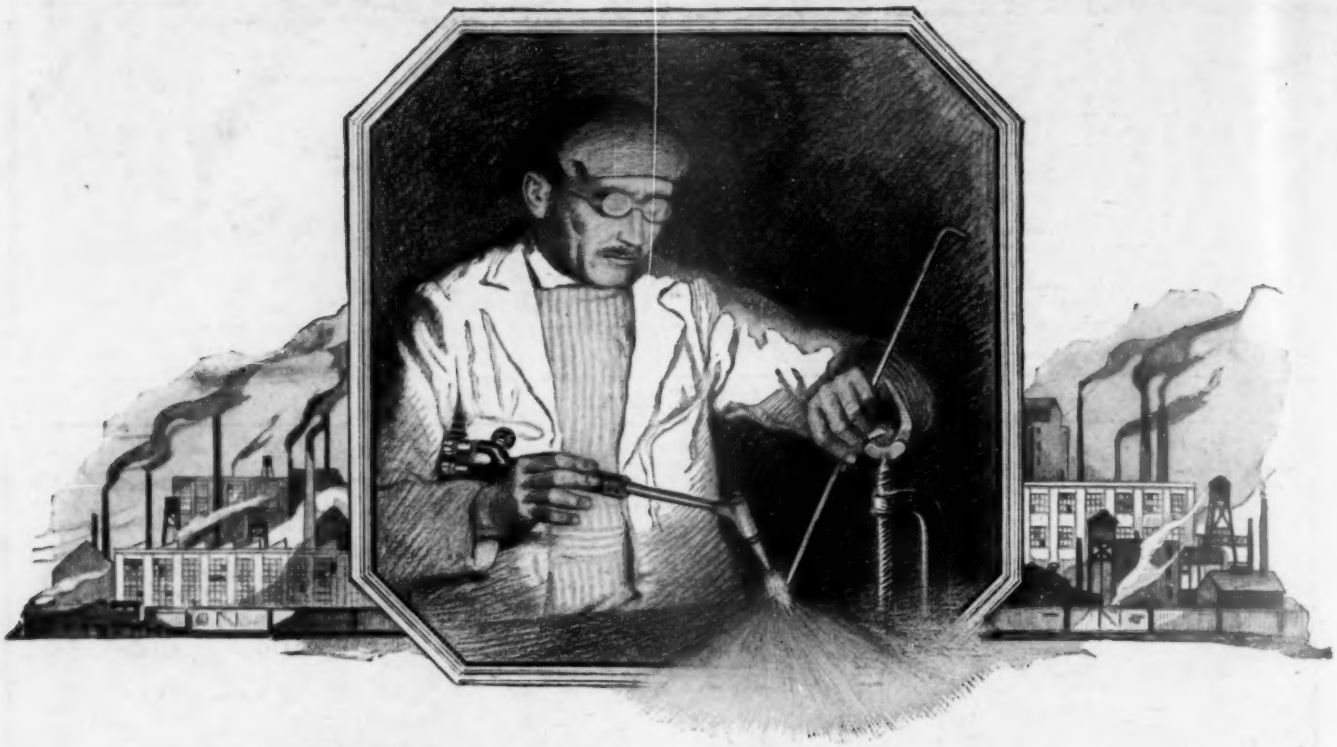
WISHBOW & DIETZ of Detroit, Michigan, large welding shop operators, welding heavy casting with two
"TORCHWELD"
Style No. 6 Heavy Duty Torches

Torchweld Equipment Company

Fulton and Carpenter Street **CHICAGO**

High Grade Welding and Cutting Apparatus, Portable and Generator Outfits, Welding Rods, Fluxes and Accessories

Published Monthly by the Welding Engineer Publishing Co. Entered as Second Class Matter Jan. 20, 1916, at the Post Office at Chicago, Ill., Under the Act of March 3, 1879.



HEAT
that can't be measured

THANKS to Oxweld—the tremendous energy of the Oxy-acetylene flame — limitless, to all intents and purposes—is ready to work *your* will at a twist of the fingers.

The oxwelder's torch has shortened production time in many hundreds of plants; and as a saver of time, labor and expense in factory repairs it pays for itself many times over annually.

In fostering and developing the oxy-acetylene process from its inception, Oxweld has taken a big part in the Nation's manufacturing development, for there is scarcely a branch of industry to which oxwelding and cutting is not applied to great advantage.

There are Oxweld Service Engineers in more than fifty important cities, ready to investigate the Oxweld possibilities of your plant.

Write, wire or telephone to any of the addresses below for immediate attention.

OXWELD ACETYLENE COMPANY

WORLD'S LARGEST MAKER OF EQUIPMENT FOR OXWELDING AND CUTTING METALS

NEWARK, N. J.

CHICAGO SAN FRANCISCO

O-532

With the use of carbon accessories a great saving of time and money can be effected

HIGHLY REFRACTORY

LOW COEFFICIENT OF EXPANSION DUE TO HEAT

MECHANICALLY STRONG

IN MANY SHAPES AND SIZES

—by holding the molten metal to the welding area with carbon plates, a cracked locomotive cylinder was welded without the usual costly removal of the cylinder from the frame.

There are many places where the use of carbon plates, rods, or paste may be extended with profit.

The services of our Engineering Department are always available in the solution of your welding problem.

We invite correspondence

NATIONAL CARBON COMPANY
Incorporated
Cleveland, Ohio San Francisco, Calif.
Canadian National Carbon Co., Limited
Toronto

982044

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Welding Co.
Universal Oxygen Co.
Prest-O-Lite Co.

ACETYLENE (Dissolved)
Air Reduction Sales Co.
Linde Air Products Co.

ACETYLENE CYLINDERS

ACETYLENE GENERATORS
Air Reduction Sales Co.
Bermo Supply Co.
Davis-Bournonville Co.
Reid-Avery Co.
The Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.

ALUMINUM FILLER RODS
Air Reduction Sales Co.
Bermo Supply Co.
Burdett Oxygen Co.
Wm. Cramp & Sons
Electric Arc Cutting & Welding Co.
Iron City Foundry Co.
Kentucky Oxygen-Hydrogen Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

ALUMINUM FLUX
Air Reduction Sales Co.
Alloy Welding Products Co.
American Flux Co.
Burdett Oxygen Co.
Kentucky Oxygen-Hydrogen Co.
Cortland Welding Compound Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Morey Flux & Chemical Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

ALUMINUM SOLDER
Air Reduction Sales Co.
Burdett Oxygen Co.

ANNEALING FURNACES
Aeroil Burner Co.
Buffalo Dental Mfg. Co.
General Electric Co.
Universal Oxygen Co.

APRONS (Asbestos)
Chicago Eye Shield Co
F. D. Farnum & Co.
Electric Arc Cutting & Welding Co.

ASBESTOS GLOVES
Air Reduction Sales Co.
Burdett Oxygen Co.
Chicago Eye Shield Co.
F. D. Farnum & Co.
Imperial Brass Co.
Universal Oxygen Co.
Weldit Acetylene Co.

ASBESTOS SHEET PAPER
Air Reduction Sales Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
F. D. Farnum & Co.
Imperial Brass Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co
United States Welding Co.
Universal Oxygen Co.
Weldit Acetylene Co.

BLOW TORCHES (Acetylene)
See "Torches"

BOOKS (Relating to Welding)
The Welding Engineer

Rochester Welding Works

We not only do welding, but supervise the design and installation of oxy-acetylene welding plants; report on welding material and methods; make tests on welding apparatus for efficiency and economy.

Nine years' experience.

Rochester Welding Works
349 Orchard St., Rochester, N.Y.
S. W. MILLER, M. E., Proprietor

ATLANTIC WELDING WORKS
Production Reclamation Welding
Electric-Arc-Spot-Oxy-Acetylene
30th and Spring Garden Streets
PHILADELPHIA, PA.

Electric Arc Cutting & Welding Co.

BRASS AND BRONZE FLUX
Air Reduction Sales Co.
Burdett Oxygen Co.
Cortland Welding Compound Co.
Hauck Mfg. Co.
Bermo Supply Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
The Imperial Brass Mfg. Co.
Krembs & Co.
Modern Engineering Co.
United States Welding Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Standard Mfg. Co.
Torchweld Equipment Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

BRASS SPELTER WIRE
Air Reduction Sales Co.
Burdett Oxygen Co.
Universal Oxygen Co.
Torchweld Equipment Co.
Weldit Acetylene Co.

BRAZING COMPOUND
Krembs & Co.
Standard Mfg. Co.
Victor Oxy-Acetylene Equipment Co.

BRAZING OUTFITS
Buffalo Dental Mfg. Co.
Aeroil Burner Co.
Hauck Mfg. Co.
Imperial Brass Co.
Superior Oxy-Acetylene Machine Co
Torchweld Equipment Co.

BRONZE FILLER RODS
Air Reduction Sales Co.
Wm. Cramp & Sons
Electric Arc Cutting & Welding Co.
Burdett Oxygen Co.
Hauck Mfg. Co.
Bermo Supply Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

CABLE (For Leads)
Electric Arc Cutting & Welding Co.
General Electric Co.

CARBIDE (Calcium)
Shawinigan Products Corp.
Union Carbide Sales Co.

CARBON (Blocks, Paste, Etc.)
National Carbon Co.
U. S. Welding Co.
Electric Arc Cutting & Welding Co.
Standard Carbon Co.
Weldit Acetylene Co.

CARBON REMOVING TORCHES
See "Torches"

CAST IRON FILLER RODS AND FLUX
Air Reduction Sales Co.
Bermo Supply Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Cortland Welding Compound Co.
Wm. Cramp & Sons
Electric Arc Welding & Cutting Co.
Iron City Foundry Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
Hauck Mfg. Co.
International Oxygen Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Imperial Brass Mfg. Co.
Superior Oxy-Acetylene Machine Co
Standard Mfg. Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

COPPER FLUX
Air Reduction Sales Co.

CUTTING RODS (Elec. Arc)
Electric Arc Cutting & Welding Co.

CYLINDERS
Wm. Wharton, Jr., & Co.

ELECTRIC ARC WELDING OUTFITS
Electric Arc Welding & Cutting Co.
General Electric Co.
Gibb Instrument Co.
Lincoln Elec. Co.
Quasi Arc Weldtrode Co.
Westinghouse Elec. & Mfg. Co.

ELECTRODE HOLDERS
Electric Arc Welding & Cutting Co.
General Electric Co.
Roy O. Williams

ELECTROLYTIC CELLS
Burdett Oxygen Co.
International Oxygen Co.
The Electrolabs Co.
Universal Oxygen Co.

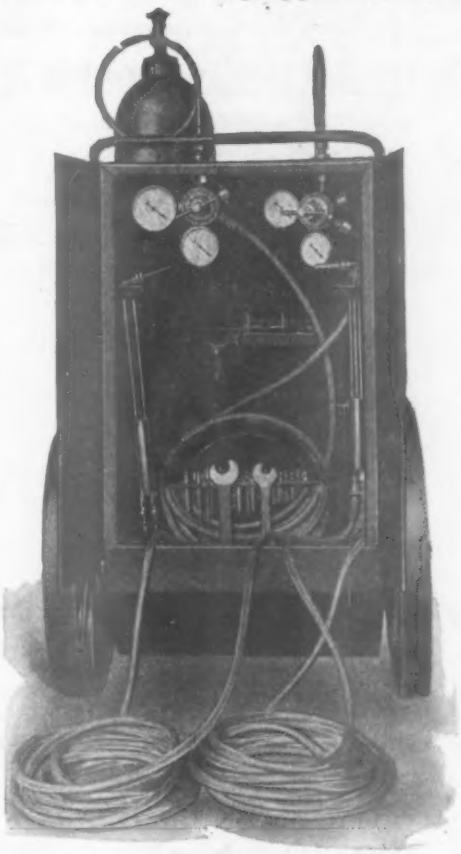
ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Burdett Oxygen Co.
The Electrolabs Co.
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
Air Reduction Sales Co.
Bierman-Everett Fdy. Co.
Burdett Oxygen Co.
Hauck Mfg. Co.
Electric Arc Cutting & Welding Co.
Imperial Brass Co.
International Oxygen Co.
Kentucky Oxygen-Hydrogen Co.

Portable Welding & Cutting Outfits with Cabinet Truck

This complete oxy-acetylene welding and cutting outfit with cabinet truck and platform for oxygen and acetylene cylinders provides the most desirable form of portable equipment for shop, yard and field use, combining convenience, safety and protection from meddling. It was first designed for the War Department, but its manifold advantages for general commercial use were immediately apparent, and met instant approval.

The truck is of all-steel welded construction, combining a steel cabinet or locker with two folding doors and platform for cylinders, mounted on two wide tired wheels of 30-inch diameter. Complete welding and cutting outfit is contained within the cabinet, the regulating valves in fixed position, attached to inside top of cabinet, and in full view of operator. Connections from regulators to oxygen and acetylene tanks are made with ¼-inch seamless brass coils. Illustration shows truck with doors open, and ready for use.



The cylinders are held firmly in upright position by chains which are drawn tight by means of eye-bolts and wing nuts inside the cabinet. All danger of cylinders being tipped over and regulators attached to cylinders being broken, is done away with. There is ample space in the cabinet for welding supplies and accessories. When through work, the operator hangs the torch in the cabinet, closes the cylinder valves, and locks the cabinet doors. The truck may be left on the job, with assurance that all adjustments and connections will be found as they were left, when the operator returns to work.

Write for Bulletin 507, illustrating cabinet trucks and other portable outfits.

Davis-Bournonville apparatus provides the widest range of equipment made for successful employment of oxy-acetylene and oxy-hydrogen welding and cutting, including individual acetylene, oxygen and hydrogen generating and compressing systems, stationary shop and factory equipment, portable shop and field outfits, and many exclusive developments for mechanical cutting and welding—backed by the longest experience in successful application, and with engineering service. Requests for information will bring cheerful response.

Davis-Bournonville Company

Factories and General Offices, Jersey City, N. J.
Canadian Factory and Offices, Toronto, Ontario

Atlanta
Boston
Buffalo
Chicago
Cincinnati
Cleveland
Dallas
Detroit
Los Angeles

WELDING AND CUTTING
DAVIS
APPARATUS
DAVIS-BOURNONVILLE CO. N.Y.

Minneapolis
Montreal
Philadelphia
Pittsburgh
Portland
St. Louis
San Francisco
Seattle
Toronto

Modern Engineering Co.
Rohde Laboratory Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Weldit Acetylene Co.

FILLER RODS (Swedish Iron)
Air Reduction Sales Co.
Bierman-Everett Fdy. Co.
Burdett Oxygen Co.
Bermo Supply Co.
Wm. Cramp & Sons
Kentucky Oxygen-Hydrogen Co.
Electric Arc Cutting & Welding Co.
Davis-Bournonville Co.
Federal Tool & Alloy Steel Corp.
Hauck Mfg. Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

FILLER RODS (Tobin Bronze)
Air Reduction Sales Co.
Burdett Oxygen Co.
Bermo Supply Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

FILLER RODS (Vanadium Steel)
Air Reduction Sales Co.
Bermo Supply Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Universal Oxygen Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Reid-Avery Co.
Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

FILLER RODS (Nickel and Nickel Alloy)
Electrical Alloys Corporation.

FIREPROOF PLASTIC
Bermo Supply Co.
National Carbon Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
American Flux Co.
Cortland Welding Compound Co.
Anti-Borax Compound Co.
Imperial Brass Co.
Krembs & Co.
Modern Engineering Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

FURNACES (Annealing)
Aeroil Burner Co.
Buffalo Dental Mfg. Co.
General Electric Co.
Hauck Mfg. Co.
Universal Oxygen Co.

PREHEATING FURNACES
Aeroil Burner Co.
Buffalo Dental Mfg. Co.
Giest Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Superior Oxy-Acetylene Machine Co.

GAS BURNERS (Preheating)
Air Reduction Sales Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

GAS FLOW INDICATORS
Hanau Engineering Co.

GAUGES
U. S. Gauge Co.

GENERATORS (Oxygen or Hydrogen)
Burdett Oxygen Co.
The Electrolabs Co.
International Oxygen Co.
Universal Oxygen Co.

GLOVES (Welders Asbestos)
Burdett Oxygen Co.
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
International Oxygen Co.
Imperial Brass Co.
Torchweld Equipment Co.
F. D. Farnum & Co.
Weldit Acetylene Co.

GOGGLES
Chicago Eye Shield Co.
J. E. Histed
The Alexander Milburn Co.
Imperial Brass Co.
Modern Engineering Co.
Victor Oxy-Acetylene Equipment Co.
Willson Goggles, Inc.

GRINDING MACHINES
Wodack Electrical Tool Corporation.

HARDENING FURNACES
Aeroil Burner Co.
Buffalo Dental Mfg. Co.
General Electric Co.
Hauck Mfg. Co.

HOSE (Oxygen and Acetylene)
Air Reduction Sales Co.
Burdett Oxygen Co.
Bermo Supply Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

HOSE UNIONS
Aeroil Burner Co.
Air Reduction Sales Co.
Bermo Supply Co.
K-G Welding & Cutting Co.
Hauck Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Universal Oxygen Co.

HYDROGEN GENERATING APPARATUS
Burdett Oxygen Co.
Electrolytic Oxy-Hydrogen Laboratories, Inc.
International Oxygen Co.
Universal Oxygen Co.

HYDROGEN PLANTS
Burdett Oxygen Co.
Electrolytic Oxy-Hydrogen Laboratories, Inc.
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Air Reduction Sales Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.

NEEDLE VALVES
Air Reduction Sales Co.
Burdett Oxygen Co.
The Bastian-Blessing Co.
Universal Oxygen Co.
Bermo Supply Co.
Buffalo Dental Mfg. Co.
Federal Brass Works.
General Welding & Eqpt. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

NICKEL FLUX
American Flux Co.

NITROGEN
Air Reduction Sales Co.
Linde Air Products Co.

OIL BURNERS (Preheating)
Aeroil Burner Co.
Air Reduction Sales Co.
Gas Products Assn.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
H. A. Smock
Superior Oxy-Acetylene Machine Co.

OXYGEN (Compressed in Cylinders)
Air Reduction Sales Co.
Burdett Oxygen Co.
Gas Products Ass'n.
International Oxygen Co.
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

OXYGEN AND HYDROGEN GENERATING EQUIPMENT
The Electrolabs Co.
Burdett Oxygen Co.
Gas Products Assn.
International Oxygen Co.
Universal Oxygen Co.

OXYGEN CYLINDERS

PIPE WELDING
Metal & Thermit Corp.
Preheaters Giest Mfg. Co.

PREHEATING FURNACES (Artificial or Natural Gas and Oil Fuel)
Giest Mfg. Co.

PRESSURE GAUGES
Aeroil Burner Co.
Air Reduction Sales Co.
Bastian & Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
Hauck Mfg. Co.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Weldit Acetylene Co.

REGULATING VALVES (Acetylene)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
Hauck Mfg. Co.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Universal Regulator Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

REGULATING VALVES (Hydrogen)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Burdett Oxygen Co.
Bermo Supply Co.
Federal Brass Works.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Universal Oxygen Co.
Weldit Acetylene Co.
Universal Regulator Co.
Harris Calorific Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

REGULATING VALVES (Oxygen)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Imperial Brass Mfg. Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

SOLDERS
Rhode Laborator Supply Co.

TORCHES (Oxy-Acetylene Welding and Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Victor Oxy-Acetylene Eqpt. Co.
Kentucky Oxygen-Hydrogen Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Weldit Acetylene Co.

TORCHES (Oxy-Hydrogen Welding and Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Harris Calorific Co.

Texas Headquarters for Welding and Cutting. The Best Equipped Plant in the State.

Southern Welding & Machine Co.
212-14 College Street
San Antonio, Texas

Burdett Oxygen Co.
Federal Brass Works.
Harris Calorific Co.
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Eqpt. Co.
Weldit Acetylene Co.

SCORED CYLINDERS
L. Lawrence & Co.

SEAM WELDERS (Electric)
General Electric Co.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)
Air Reduction Sales Co.
International Oxygen Co.
Superior Oxy-Acetylene Machine Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.
Universal Oxygen Co.
Weldit Acetylene Co.

THERMALENE-GAS
The Thermalene Co.

THERMIT WELDING
Metal & Thermit Corp.

TORCHES (Gasoline and Kerosene Preheating)
Aeroil Burner Co.
Air Reduction Sales Co.
Buffalo Dental Mfg. Co.
The Imperial Brass Mfg. Co.

Davis-Bournonville Co.
147 W. Austin Ave. Chicago

Davis-Bournonville Co.
Marion Jersey City

Davis-Bournonville Co.
316 Penn Ave. Pittsburgh

UNION CARBIDE

WORLD'S BEST QUALITY—HIGHEST GAS YIELD

ALWAYS PACKED IN BLUE AND GRAY DRUMS

Large stocks of Union Carbide in all regular commercial sizes are carried at each of Union Carbide Sales Company's Warehouses listed below.

Requests for information and special correspondence should be addressed to our New York, Chicago or San Francisco offices.

Generator Sizes of Union Carbide

Packed in 100 Pound Drums

3½ in. x 2	in.	(Lump)
2 in. x ½	in.	(Egg)
1¼ in. x ⅜	in.	(Nut)
¼ in. x 1/12	in.	(Quarter)

For Oxy-Acetylene Welding and Cutting Plants, Acetylene House Lighting Plants, Contractors' Torches and Flare Lights, and numerous other pieces of Acetylene generating apparatus designed for the use of one of these sizes of Carbide.

UNION CARBIDE SALES COMPANY

Peoples Gas Building
Chicago, Ill.

Carbide and Carbon Building
30 East 42nd St.
New York

Balfour Building
California and Sansome Sts.,
San Francisco, Calif.

UNION CARBIDE SALES COMPANY'S WAREHOUSES

Shipments Always Made On Day Orders Are Received

ALABAMA
Birmingham.....1916 Morris Ave.
Mobile.....16 S. Commerce St.
Montgomery.....114 N. Perry St.

ARIZONA
Phoenix.....42 S. Central Ave.

ARKANSAS
Ft. Smith.....15 North Fourth St.

CALIFORNIA
Fresno.....932 H St.
Los Angeles.....639 Gibbon St.
Sacramento.....217 O St.
San Diego.....Seventh and J Sts.
San Francisco.....Balfour Bldg.

COLORADO
Denver.....Nineteenth and Wazee Sts.

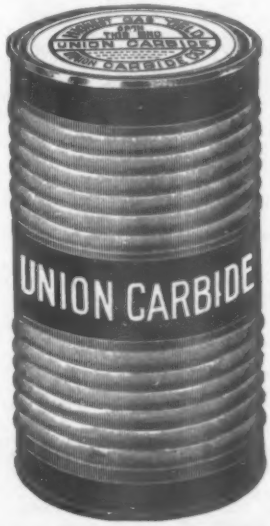
CONNECTICUT
Hartford.....412 Trumbull St.

DISTRICT OF COLUMBIA
Washington.....501 Second St., N. E.

FLORIDA
Jacksonville.....13 Cedar St.
Tampa.....805 Tampa St.

GEORGIA
Atlanta.....P. O. Box 1594
Savannah, Ogeechee Canal, S. of Bay St. P. O. Box 78

ILLINOIS
Chicago.....122 So. Michigan Boulevard
Decatur.....133 W. William St.
East St. Louis.....700 Broadway
Phones Bell-Bridge 320, Kinloch-St. Clair 320
Marion..315 S. Granite St., P. O. Box 747
Monmouth.....124 E. Archer Ave.
Peoria.....100-110 Edmund St.
Phones Main 700-701, Interstate 7000
Quincy...828 Vermont St., P. O. Box 255
Springfield.....217 South Fourth St.
Streator.....702 East Elm St.



INDIANA
Evansville.....1601 Illinois St.
Fort Wayne.....2216 Broadway
Indianapolis.....110-112 S. Alabama St.
Phones Bell-Main 2410, Independent 27-474
Terre Haute.....921 Wabash Ave.

IOWA
Davenport.....118 Harrison St.
Des Moines.....Third and Elm Sts.
Dubuque.....8th and Washington Sts.
Fort Dodge.....Central Ave. at 16th St.
Ottumwa.....207-9-11 S. Washington St.
Sioux City..925 Fourth St., P. O. Box 398
Waterloo.....1209 East Fourth St.

KANSAS
Pittsburg.....109 W. Third St.
Salina.....154 N. Fifth St.
Wichita....Douglas and Sycamore Aves. P. O. Box 951

KENTUCKY
Louisville.....126 E. Main St.
Middlesboro.....1701 Cumberland Ave.

LOUISIANA
New Orleans.....4124 Toulouse St.

MAINE
Portland.....11 Exchange St.

MARYLAND
Baltimore.....19 E. Lombard St.
Cumberland....53 Third Nat'l Bk. Bldg.
Salisbury...Mill St., Opp. Fulton Station

MASSACHUSETTS
Springfield ..... Napier St.
Worcester..... 15 Federal St.

MICHIGAN
Detroit.....Federal and Junction Aves.
Grand Rapids..500 Shawmut Ave., N. W.
Hancock.....First Nat'l Bank Bldg.
Iron Mountain.....513 Stephenson Ave.
Jackson.....172 South Water St.
Muskegon.....303 W. Western Ave.
Saginaw.....1830-1840 N. Michigan Ave.
Sault Ste. Marie.....

MINNESOTA
Minneapolis.....334 N. First St.
Phones Nicollet 7121, Tri City-Automatic 38634
Virginia.....413 Chestnut St.

MISSISSIPPI
Vicksburg.....1312 Washington St.

MISSOURI
Kansas City.....1422 St. Louis Ave.
St. Joseph.....920 Sixth St., Sta. "A"
St. Louis.....(See East St. Louis, Ill.)

NEBRASKA
Omaha.....1007-9-11 Jones St.
Union Sta. P. O.

NEW JERSEY
Camden.....West and Clinton Sts.
Newark.....251-55 Ridgewood Ave.

NEW YORK
Albany.....108 Third Ave.
Binghamton.....21 Jarvis St.
Phones Long Distance 467, York State 210, Bell 2450
Buffalo.....1336 Genesee St.
Geneva.....Exchange St. & R. R. Place
Hurleyville .....
Jamaica.....11 New York Ave.
Kingston.....O'Neil St., Near Broadway
Niagara Falls .....
Poughkeepsie.....Smith St. and N. Y., N. H. & H. R. R. Tracks
Utica..... 135 Hotel St.
Watertown..... 438 Court St.
Whitehall..... 22-23 Main St.

NORTH CAROLINA
Charlotte.....205 W. First St.
Wilmington.....13 N. Front St.
Raleigh.....P. O. Box 149

NORTH DAKOTA
Fargo.....Fifth St. and Second Ave.

OHIO
Canton.....638 Mulberry Road
Cincinnati..67 Plum St., Phone Main 682
Cleveland.....601 The Citizens' Bldg.
Columbus.....330 Dublin Ave.
Dayton.....812-828 E. First St.
Lima.....338 East High St.
Mansfield...40 West Third St., Phone 69
Steubenville.....324-343 N. Seventh St.
Toledo.....414 S. Erie St.
Youngstown.....Jones and Brittain Sts.
Zanesville.....Main and 2nd Sts.

OKLAHOMA
Oklahoma.....4 West Park Place
Tulsa.....1-11 N. Boulder St.

OREGON
Portland.....15th and Hoyt Sts.

PENNSYLVANIA
Beaver..... 359 Beaver St.
DuBois....Weber Ave. and Franklin St.
East Greensburg..Clark and George Sts.
Erie..... 1426 Chestnut St.
Harrisburg.....25 S. Tenth St.
Johnstown, Messenger St. and B. & O. R.R.
Pittsburgh .....1202 Chamber of Commerce Bldg.
Pottsville....Railroad and Sanderson St.
Scranton.....Penn Ave. and Vine St.
Shamokin.....Fifth and Walnut Sts.
Williamsport.....Canal and Court Sts.

SOUTH CAROLINA
Charleston..3 N. Liberty St., Phone 2716

TENNESSEE
Chattanooga .....627 Volunteer State Insurance Bldg.
Knoxville.....426 West Depot Ave.
Memphis.....671 South Main St.
Nashville..... 105-107-109 Broadway

TEXAS
Dallas.....Wood and Market Sts.
El Paso..First and Kansas Sts., Phone 50
Houston .....Baker and Cedar Sts., P. O. Box 1214
San Antonio .....Leal and N. Salado Sts., Box 942
Waco..Thirteenth & Mary Sts., Phone 23

UTAH
Salt Lake City..108 W. Second South St.

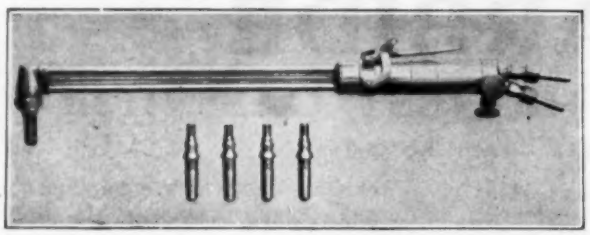
VIRGINIA
Lynchburg..... 1324 Commerce St.
Norfolk..... 513 Front St.
Richmond.....18th and Cary Sts.

WEST VIRGINIA
Bluefield.....195 Roanoke St.
Charleston..Broad St. and K. & M. R. R.
Elkins.....Railroad Ave. and First St.
Fairmont ..... "A" St.
Huntington...Seventh Ave. & Eighth St.
Morgantown.....178 Clay St., Phone 20
Wheeling.....43rd and McCulloch St.

WASHINGTON
Seattle.....1103 First Ave.
Spokane..162 So. Post St., Phone Riv-96

WISCONSIN
La Crosse.....Front and King Sts.
Madison..... 513-19 Williamson St.
Milwaukee..... 120 Jefferson St.

UNION CARBIDE IS EASILY OBTAINABLE EVERYWHERE



THE "K-G" TORCH

FOR

CUTTING RIVETS,
BOILER TUBES,
PLATE CUTTING and
GENERAL WORK

CANNOT BE BEATEN

All we ask is an unbiased comparison and test.
Complete equipment and all accessories and supplies for gas welding and cutting.

OXYGEN—ACETYLENE

K-G Welding & Cutting Co.

Incorporated

556 West 34th St., New York City

Preheating medium sized jobs is readily accomplished with the HAUCK No. 56 Torch, as illustrated.
It develops a Clean, Mild, Uniform Flame.
Oil Consumption—3 Quarts per hour.
Flame length—22 Inches.
Legs welded on tank bottom insuring firm setting.
Write for Bulletin No. 103 illustrating complete line of HAUCK Pre-heating Equipment.

"BEST by TEST"

HAUCK MANUFACTURING COMPANY

104-114 Tenth Street and 101-113 Eleventh Street
Brooklyn, N. Y.

Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
Harris Calorific Co.
International Oxygen Co.
Kentucky Oxygen-Hydrogen Co.
Modern Engineering Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
H. A. Smock
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.
Oxweld Acetylene Co.

TRUCKS (Cylinder Carriers)
Air Reduction Sales Co.
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
Modern Engineering Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
The Bastian-Blessing Co.
Air Reduction Sales Co.
Burdett Oxygen Co.

VALVES (For Oxygen Cylinders)
Air Reduction Sales Co.
International Oxygen Co.
Safety Car Heating & Lighting Co.
Universal Oxygen Co.

WELDING APPARATUS (Electric)
Electric Arc Welding & Cutting Co.
General Electric Co.
Gibb Instrument Co.
Lincoln Elec. Co.
Quasi Arc Weldtrode Co.
Westinghouse Elec. Mfg. Co.

WELDERS' GLOVES
Air Reduction Sales Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Universal Oxygen Co.
Weldit Acetylene Co.

WELDERS' GOGGLES
Air Reduction Sales Co.
Burdett Oxygen Co.
The Imperial Brass Mfg. Co.
Chicago Eye Shield Co.
J. E. Histed
International Oxygen Co.
Modern Engineering Co.
Universal Oxygen Co.

WELDERS MASKS
Electric Arc Welding and Cutting Co.
General Electric Co.
Torchweld Equipment Co.

WELDING RODS AND WIRE
Air Reduction Sales Co.
Electric Arc Cutting & Welding Co.
Atlas Foundry Co.
Bierman-Everett Fdy Co.
Burdett Oxygen Co.
William Cramp & Son
Iron City Foundry Co.
Kentucky Oxygen-Hydrogen Co.
The Imperial Brass Mfg. Co.
Federal Tool & Alloy Steel Corp.
International Oxygen Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
Universal Oxygen Co.
Weldit Acetylene Co.

WIRE AND CABLE (Asbestos Insulated)
D. & W. Fuse Works, General Electric Co.

ALPHABETICAL INDEX TO ADVERTISERS

A
Aeroil Burner Co. 58
Air Reduction Sales Co. 59
Anti-Borax Compound Co. 16
Alloy Products Co. 58
Atlantic Welding Works 4
Atlas Foundry Co. 58

B
Bastian-Blessing Co., The 30-31
Bermo Supply Co. 56
Bierman-Everett Fdy. Co. 9
The Buckeye Welding & Sup. Co. 58
Buffalo Dental Mfg. Co. 16
Burdett Oxygen Co. 20

C
Chicago Eye Shield Co. 41
Commercial Acetylene Supply Co. Back Cover
Cortland Welding Compound Co. 49
Wm. Cramp & Sons 51

D
Davis-Bournonville Co. 5

E
The Electrolabs Co. 57
Electric Alloys Co.
Electric Arc Welding & Cutting Co. 41

F
F. D. Farnam & Co. 49
Federal Brass Works 17
Federal Tool & Alloy Steel Corp. 49

G
General Electric Co. 33
Giest Mfg. Co.
General Welding & Equipment Co.
Gas Products Assn. 13
Gas Tank Recharging Co. 11
Gibb Instrument Co. 21

H
Harris Caloric Co. 57
Hauck Manufacturing Co. 8
J. E. Histed 54
Hydrex Engineering Co. 56

I
Imperial Brass Mfg. Co. 12
International Oxygen Co. 15
Iron City Foundry Co. 58

K
Kentucky Oxygen-Hydrogen Co. 55
K-G Welding & Cutting Co. 8
Krembs & Co. 56

L
Linde Air Products Co. 22
Lincoln Electric Co. 14
L. Lawrence & Co. 53

M
Metal & Thermit Corp. 35
The Alexander Milburn Co. 10
Morey Flux & Chemical Co. 58
Modern Engineering Co. 49

N
National Carbon Co. 3

O
Oxweld Acetylene Co. 2

P
Page Steel & Wire Co.
The Prest-O-Lite Co., Inc. 39

Q
Quasi Arc Weldtrode Co.

R
Reid-Avery Co. 19
Rohde Laboratory Supply Co.
Rochester Welding Wks. 4
John A. Roebling's Sons Co.

S
Safety Car Heating & Lighting Co. 21
Smith's Inventions, Inc. 11
H. A. Smock 58
Superior Oxy-Acetylene Machine Co. 41
Southern Welding Machine Co. 6
Swift & Co. 17
Standard Mfg. Co. 58
Standard Carbon Co. 16
Shawinigan Products Corporation 16

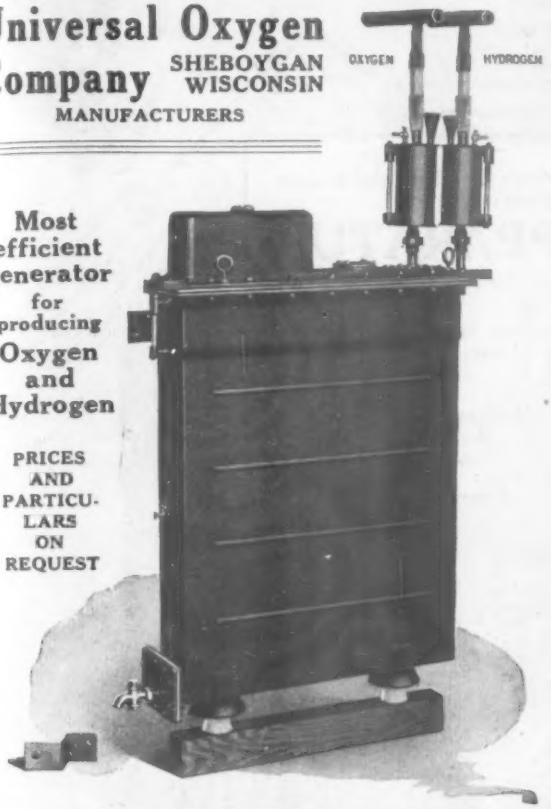
T
The Thermalene Co. 58
Torchweld Equipment Co. Front Cover
Transportation Engineering Corp. 21

U
Union Carbide Sales Co. 7
United Marine Contracting Corp. 15
U. S. Gauge Co. 9
United States Welding Co. 51
Universal Oxygen Co. 1

V
Victor Oxy-Acetylene Eqpt. Co. 13

W
Westinghouse Elec. Mfg. Co.
Weldit Acetylene Co.
Wm. Wharton, Jr., & Co., Inc. 57
R. O. Williams 57
Willson Goggles, Inc. 47
Wodack Electric Tool Corporation 56

Universal Oxygen Company
SHEBOYGAN WISCONSIN
MANUFACTURERS



Most efficient generator for producing Oxygen and Hydrogen

PRICES AND PARTICULARS ON REQUEST

ELECTROLYTIC OXYGEN & HYDROGEN CELL MODEL C

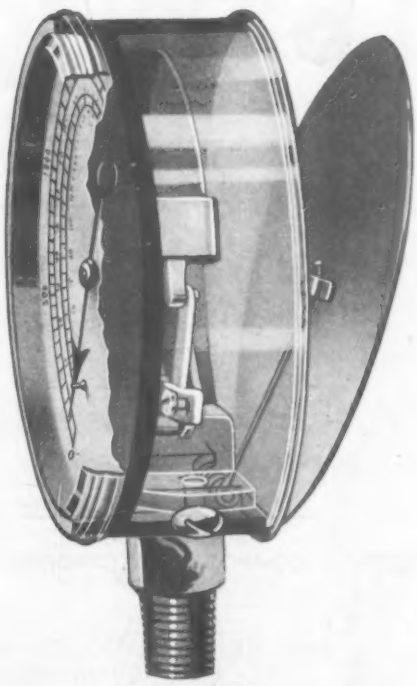
Welding Rods

CAST IRON
MALLEABLE IRON
NORWAY IRON
NICKEL STEEL
VANADIUM STEEL
CAST ALUMINUM
MANGANESE BRONZE
TOBIN BRONZE

FLUXES FOR WELDING ALL MATERIALS

QUALITY GUARANTEED

Bierman-Everett Foundry Co.
133-153 So. 20th St. Irvington, N. J.



SOLFRUNT
(*Patented*)

U.S. GAUGE CO. N.Y.
Trade Mark

DEVELOPED TO MEET THE REQUIREMENTS OF THE INDUSTRY—U. S. oxy-acetylene gauges have conclusively proven they are superior in every way.

THE DESIGNS ARE PATENTED and embody exclusive features.

INVARIABLY THEY ARE USED ON THE BEST EQUIPMENT—in every line.

U. S. GAUGE CO.
37 Liberty St., New York, U. S. A.

Chicago Detroit Boston Philadelphia
New Orleans San Francisco Birmingham Montreal

Distributing Agents Thruout the World

From the smallest Jeweler's Torch to the largest industrial gas generating plant:

MILBURN APPARATUS

is superior in design, construction, performance and economy.

For the trade, we manufacture apparatus on your design or plan it to meet special service or conditions.

Send for Catalog No. 35

The Alexander Milburn Company
1420-1428 W. Baltimore St., Baltimore, Maryland
New York Philadelphia Pittsburgh
Chicago San Francisco

Blue Label

"RACO" MILD STEEL WELDING WIRES
ELECTRIC
CUSTOMER'S ORDER NO. SIZE
To
From REID-AVERY COMPANY
1434-36-38 Brandywine St.
PHILADELPHIA, PA

"Raco" Mild Steel Electrodes for Electric Welding

Yellow Label

"RACO" MILD STEEL WELDING WIRES
"RACO" COVERED
CUSTOMER'S ORDER NO. SIZE
To
From REID-AVERY COMPANY
1434-36-38 Brandywine St.
PHILADELPHIA, PA

"Raco" Covered Electrodes for A. C. & D. C. Welding

"RACO"
Electrodes and Welding Wire

is the adopted standard with the largest shipbuilders, railroads and industrial plants.

The mild steel used in the manufacture of "Raco" Electric Welding Wire is made by the open hearth process, the wire is made by the Reid-Avery Co., which should not be confused with jobbers.

We are in position to furnish the following sizes out of stock $\frac{5}{32}$", $\frac{1}{8}$", $\frac{5}{32}$", $\frac{3}{16}$" and $\frac{1}{4}$" diameter.

"Raco" Electric Welding Wire is sold subject to rejection from *any cause*.

Furnished in coils or straightened and cut any length. Samples cheerfully submitted for testing.

Red Label

"RACO" MILD STEEL WELDING WIRES
OXY-ACETYLENE
CUSTOMER'S ORDER NO. SIZE
To
From REID-AVERY COMPANY
1434-36-38 Brandywine St.
PHILADELPHIA, PA

"Raco" Soft Iron Rods for Oxy-Acetylene Welding

REID-AVERY CO.
1434-38 Brandywine St.
Philadelphia, Pa.

Green Label

"RACO" MANGANESE COMPOSITE ELECTRODES
TO
FROM REID-AVERY COMPANY
1434-36-38 BRANDYWINE ST.
PHILADELPHIA, PA.

"Raco" Manganese Composite Electrodes

Smith's Automatic Acetylene Generators

Made In Four Sizes

The merit and dependability of Smith's Automatic Acetylene Generators has been proven through years of actual shop service.

It saves time and money, and keeps a supply of acetylene on hand at about one-third of what it costs in drums.

In 30-50-100-200 pound Carbide Capacities

One of the four sizes of Smith's Generators will exactly meet your shop needs, —depending on the volume of work you have to do.

Write Us

—about your needs in generators or any oxy-acetylene equipment.

Write for Catalogue and Name of Your Nearest Jobber

Smith's Inventions, Inc.

Dept. 1 MINNEAPOLIS, MINN.

SUN-LITE CARBIDE

PACKED IN BROWN DRUMS

For Acetylene Compressing Plants, Oxy-Acetylene Welding Plants, House Lighting Generators, Contractors' Torches, Etc.

IN 100 lb. DRUMS

In All Commercial Sizes:

3½" x 2"
2" x ½"
1¼" x ⅜"
¼" x 1/12"

MINERS' LAMP

"Sun-Lite" Carbide is carried in stock in all large cities. Write for nearest sales agency, from which shipments will be made direct to consumer. Some desirable territory for a Sales Agency proposition still open. Address all correspondence to Home Office.

GAS TANK RECHARGING COMPANY, Milwaukee, Wisconsin

IMPERIAL

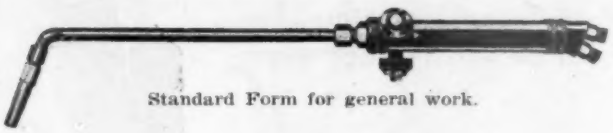
The ONLY UNIVERSAL Torch
EIGHT Welding Torches in ONE

Practical welders will instantly grasp this big advantage which may be had only with the Imperial Welding Torch!

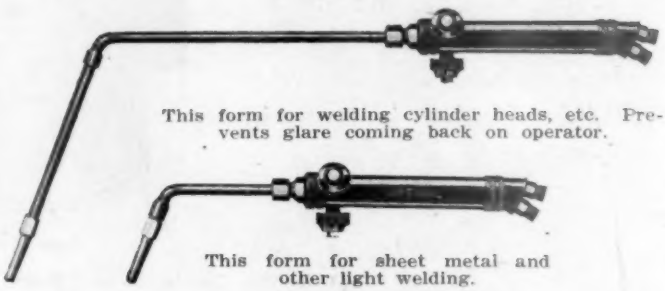
The pictures show EIGHT different forms into which the Imperial torch can be made quickly and easily by the operator, simply by using the regular equipment that is a part of every Imperial Outfit.

Note that each form makes, not a make-shift, but an ideal torch for the purpose indicated. In any of these forms you get the same perfect operation, and the flame can be regulated with the one hand which holds the torch —no need of laying down your welding rod.

Use Imperial Welding Torches—simply *one* UNIVERSAL torch for each welder—and you can do every kind of welding work.



Standard Form for general work.



This form for welding cylinder heads, etc. Prevents glare coming back on operator.

This form for sheet metal and other light welding.

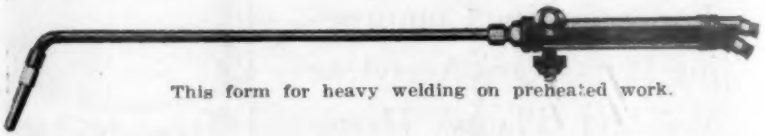
This form for cramped working space.

This form for overhead work.

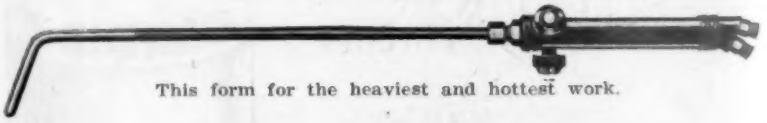
This form for left-handed operator or for welding vertical seams, etc.

IMPORTANT!

Let us tell you how the Imperial Automatic Acetylene Generator can save you from 2 to 4 cents per cubic foot of gas. No welding shop can afford to be without one. Our catalog gives full information on Welding, Cutting and Generating Equipment and Welding Supplies.



This form for heavy welding on preheated work.



This form for the heaviest and hottest work.

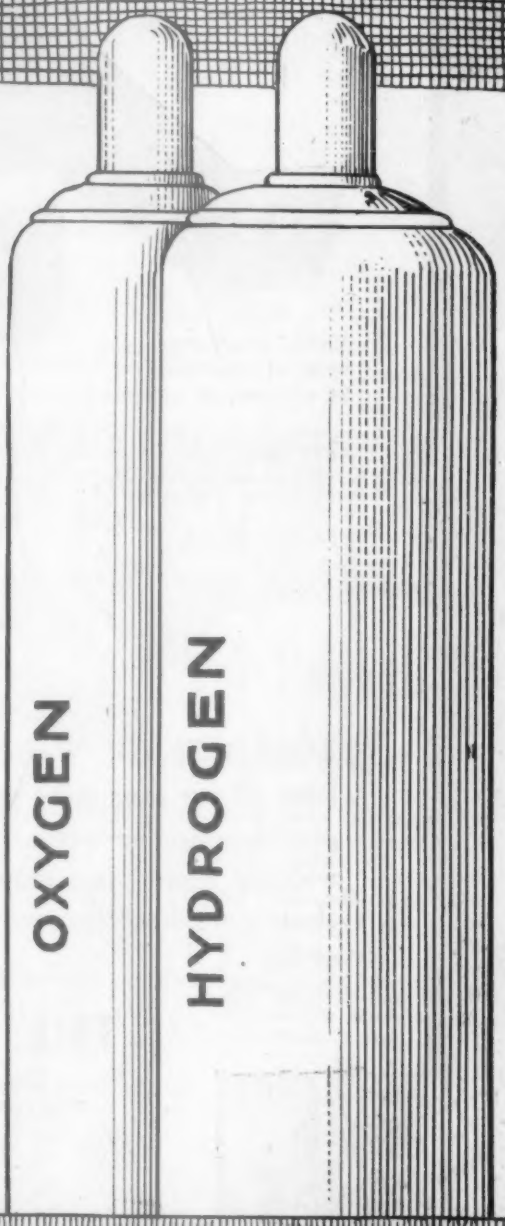
The Imperial Brass Mfg. Co.

517 S. Racine Ave. Chicago, Ill.

Makers of welding, cutting, carbon and lead burning equipment and supplies.

ABOVE 99%-

THAT'S PURITY!



Oxygen efficiency depends upon it's purity.

Specify 99% purity when buying oxygen. Then see that you get it by testing your oxygen.

We know that electrolytic oxygen is the purest you can buy. Find out for yourself. Make your own tests.

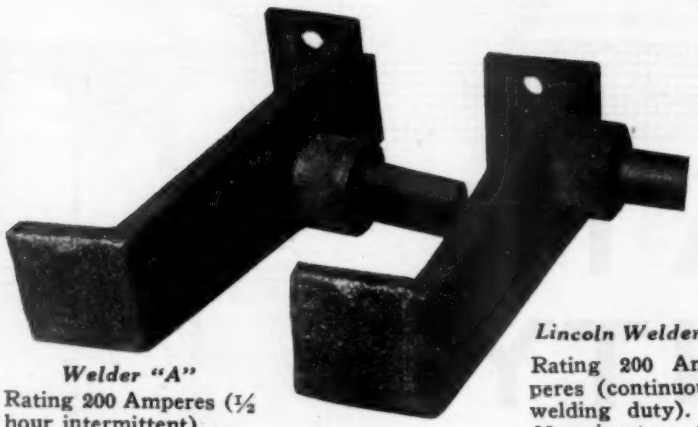
Forty-three members of the Gas Products Association have plants conveniently located throughout the United States and Canada.

Are you doing your cutting with HYDROGEN? We can tell you why you should.

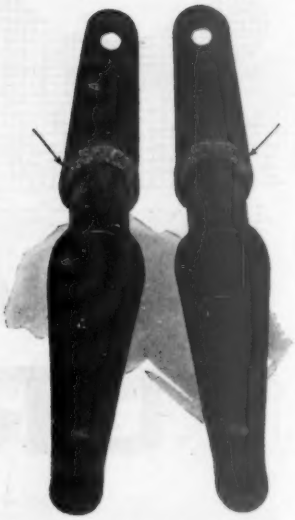
GAS PRODUCTS ASSOCIATION 801 MARQUETTE BLDG. CHICAGO, ILLINOIS

LINCOLN ARC WELDER

What Railroad Shop Tests Show



Welder "A"
Rating 200 Amperes (½ hour intermittent).
34 minutes, 21 seconds.



Lincoln Welder
Rating 200 Amperes (continuous welding duty).
20 minutes, 17 seconds.

This photograph shows two identical repair jobs in a railroad shop building up about 5 cubic inches of material on a steel brake brace.

Welder "A"
Rating 200 Amperes (½ hour intermittent).
28 minutes, 10 seconds.

Lincoln Welder
Rating 200 Amperes (continuous welding duty).
17 minutes, 14 seconds.

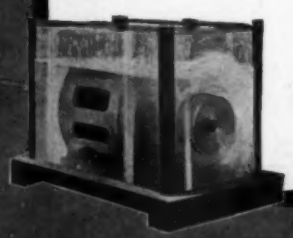
Though the welders were both rated 200 amperes, the Lincoln Welder actually used about 230 amperes and easily took care of ¼-inch electrode, while the competing welder could only use 5-32 inch electrode and consequently did much slower work.

The Lincoln Arc Welder will do at least 20 per cent more welding work per day under actual commercial welding conditions than any other electric welding equipment made.

This is a well considered statement based on results of many competitive tests, and The Lincoln Electric Co. are prepared to prove the claim at any time or place where welding is being done by commercial operators.

"Link Up with Lincoln"

This Standard Lincoln Motor operated over 3 years under water without damage.

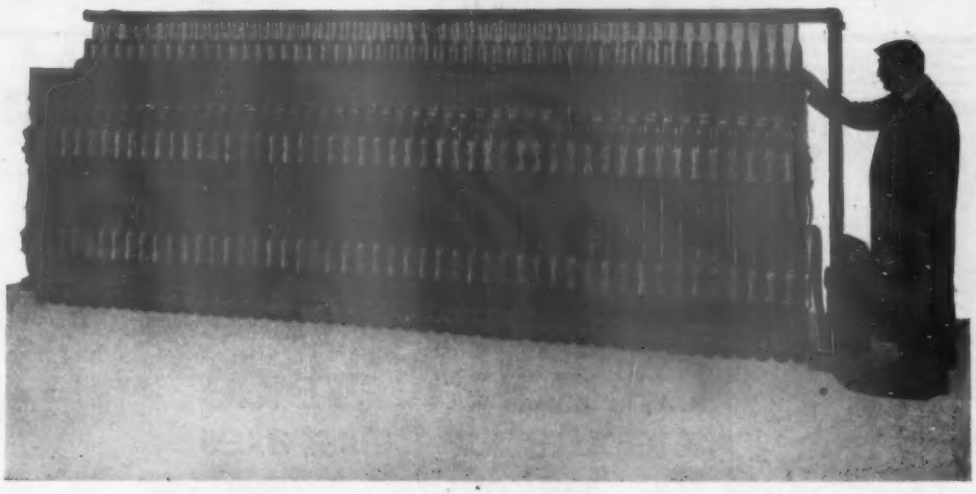


THE LINCOLN ELECTRIC CO.

General Offices and Factory, Cleveland, O.

The Lincoln Electric Co., of Canada, Ltd., Toronto-Montreal

New York City	Minneapolis	Detroit	Pittsburgh
Buffalo	Cincinnati	Hartford	Philadelphia
Syracuse	Chicago	Columbus	Boston
Baltimore			Charlotte, N. C.



THE PUREST OXYGEN

Saves Money Saves Time
Does Better Work

GAS CONSUMERS MUST CONSIDER

EFFICIENCY in cutting and welding operations :-: ECONOMY in the application
QUALITY in the finished work

Pure *Oxygen* and Pure *Hydrogen* as produced by the *I. O. C. System* are VITAL FACTORS in such considerations. A score of *I. O. C. System Commercial Plants* are ready to supply your requirements from the following points:

Atlanta, Ga.
Boston
Buffalo
Chicago
Cleveland
College Point, N. Y.
Dayton, Ohio
Davenport, Ia.
Indianapolis, Ind.
Louisville, Ky.
Hoboken, N. J.
Newark, N. J.
New York City
Omaha, Nebr.
Peoria, Ill.
Pittsburgh
Portland, Ore.
Salt Lake City
Tariffville, Conn.
Toledo, Ohio
Washington
Youngstown, Ohio

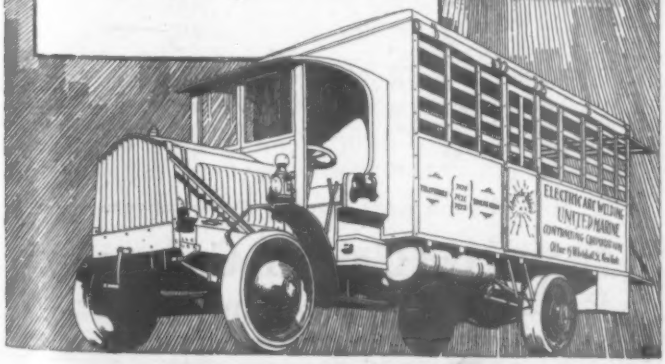
INTERNATIONAL OXYGEN COMPANY, Newark, New Jersey
LONDON NEW YORK PARIS

Something New Under the Sun

THIS big truck, from which two welders and four chippers may work simultaneously, will handle jobs at shops, piers and other points formerly inaccessible.

Nine barges equipped with the latest electric arc welding and air devices—three more with air only. Staff of expert welders.

UNITED MARINE
CONTRACTING CORPORATION
15 Whitehall Street New York City
Telephone Bowling Green 7420-7421-7422



Anti-Borax Welding Fluxes

It Pays to Use Only the Best

Better, stronger and softer welds are more easily and more quickly made with Anti-Borax Welding Fluxes. That's real economy.

For Cast Iron, Brass, Bronze Malleable Iron, Steel, Cast and Sheet Aluminum

ANTI-BORAX FLUXES are scientific preparations which weld at lower head, leave no scale, cleanse the molten metal, assist fusion, prevent cooling cracks, and leave metal soft at welds.

Anti-Borax Fluxes are the best that money can buy, yet they cost no more—usually less than inferior brands.

GUARANTEED to give perfect satisfaction or your money refunded.

Write for price list and free samples.

Anti-Borax Compound Company
FT. WAYNE, INDIANA

~REPETITION *Makes* REPUTATION

rum after drum – the uniformly high quality of the millions sold, has given

Canadian Carbide

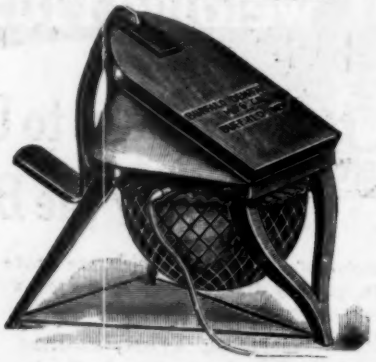
a reputation that makes the dealer glad to sell and the customer insist on the kind that *does* give

"More Gas per Pound"

SHAWINIGAN PRODUCTS CORPORATION
160 FIFTH AVENUE
New York
549 McCORMICK BUILDING
Chicago

Foot Blowers

No. 10 FOOT BLOWER, $10.75



For a simple, compact, portable arrangement to give a steady blast of air for blowpipe work or for any other operation requiring positive pressure air blast, we manufacture two styles and three sizes of foot blowers, ranging in capacities from three to ten cubic feet per minute. Our catalogue "B. X." free for the asking, gives full description. Also of preheating and brazing blowpipes.

Buffalo Dental Manufacturing Co.,
Buffalo, N. Y., U. S. A.

CARBON RODS CHEAP

High grade welding rods at following prices, F. O. B. Richmond, California, in any quantities from 1 rod up:

3/8	x 12.....	$ .05 each
7/16	x 12.....	.05 "
1/2	x 12.....	.07 "
9/16	x 12.....	.07 "
5/8	x 12.....	.07 "
3/4	x 12.....	.10 "
7/8	x 12.....	.20 "
1	x 12.....	.20 "
1 1/4	x 12.....	.35 "
1 1/2	x 12.....	.50 "
2	x 12.....	.75 "
3	x 12.....	1.50 "

For 24 inch rods double these prices.

Standard Carbon Company
R. F. D. 38A - Richmond, California

You Make a "Good" Torch

—why not get the Best Regulator?

—why not?

Make it a Federal

"FEDERAL" Regulators have been passed by the National Board of Underwriters. Should a diaphragm, for any reason, become ruptured, the gas is released through special vent holes at the rear end of the front cap, absolutely preventing any possible chance of physical injury to the operator.

"FEDERAL" Regulators are made of the very best materials by expert mechanics for expert welders who know the value of and appreciate absolutely dependable Regulators.

Federal Brass Works

31st St. and Kedzie Ave. CHICAGO

Swift's Pure Oxygen

"A Reputation Imposes an Obligation"

Swift Oxygen must pass the most rigid tests —must never vary from its high quality standard.

Swift Oxygen is produced in the largest electrolytic plant in the U. S. A.—in ample quantities to render unequalled service to our customers.

The use of Swift Oxygen in your plant will aid you in raising the standard of the work of your operators.

The Name is Your Guarantee

Swift & Company,

Oxygen Department

Union Stock Yards Chicago, Ill.

Know Welding From A to Z

THE WELDING ENCLYCOPEDIA will not only solve your welding problems, but will also give you a fund of welding knowledge that will increase the efficiency of your shop. There is reference material to cover every need, arranged so that it can be found easily, and illustrated with drawings and photographs; and there is a collection of up-to-date treatises on all forms of welding.

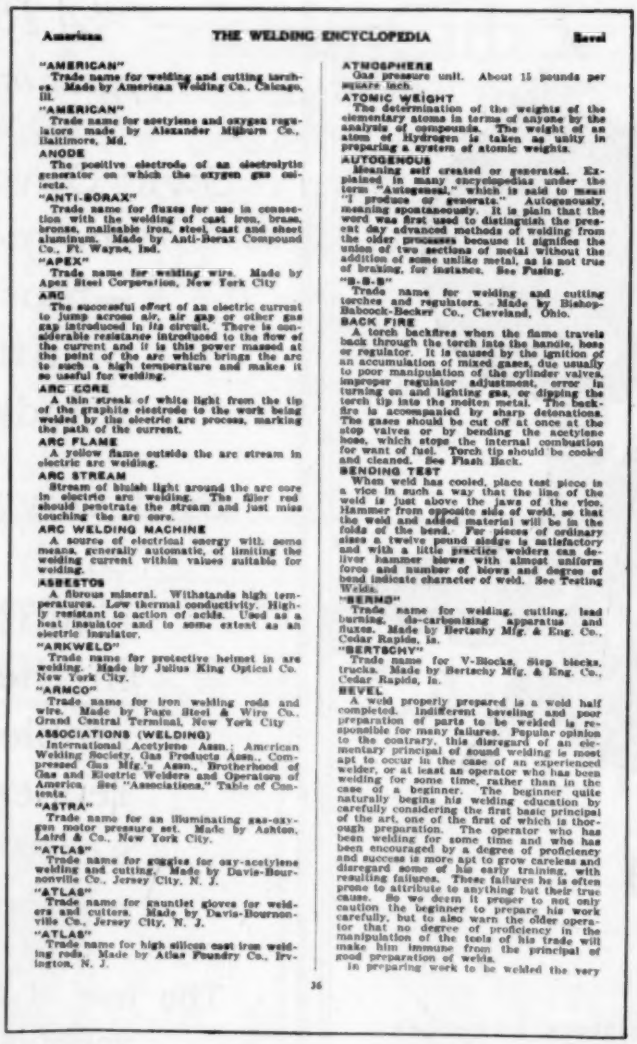
PARTIAL CONTENTS:

A complete Dictionary of all of the terms used in welding, with thorough explanations, illustrations, etc. This section alone comprises the most complete text book on the subject of welding we know of.

The Trade Names of all welding apparatus, supplies, equipment and devices used by welders, including an explanation of purposes for which used and the maker's name and address.

How to weld Iron and Steel, Cast Iron, Aluminum and all other weldable metals. Each metal is treated separately and the various processes, such as the Electric Arc, Oxy-Acetylene and Thermit processes, are treated individually. Just the sort of a book we have always wanted to recommend to our friends.

All about the laws and regulations relating to Autogenous Welding, Government Laws, Ocean and Coastwise, Rivers and Great Lakes, State and City



Americas THE WELDING ENCYCLOPEDIA Bevel

"AMERICAN"
Trade name for welding and cutting torches. Made by American Welding Co., Chicago, Ill.

"AMERICAN"
Trade name for acetylene and oxygen regulators made by Alexander Milburn Co., Baltimore, Md.

ANODE
The positive electrode of an electrolytic generator on which the oxygen gas collects.

"ANTI-BORAX"
Trade name for fluxes for use in connection with the welding of cast iron, brass, bronze, malleable iron, steel, cast and sheet aluminum. Made by Anti-Borax Compound Co., Ft. Wayne, Ind.

"APEX"
Trade name for welding wire. Made by Apex Steel Corporation, New York City

ARC
The successful effort of an electric current to jump across air, air gap or other gas gap introduced in its circuit. There is considerable resistance introduced to the flow of the current and it is this power massed at the point of the arc which brings the arc to such a high temperature and makes it so useful for welding.

ARC CORE
A thin streak of white light from the tip of the graphite electrode to the work being welded by the electric arc process, marking the path of the current.

ARC FLAME
A yellow flame outside the arc stream in electric arc welding.

ARC STREAM
Stream of bluish light around the arc core in electric arc welding. The filler rod should penetrate the stream and just miss touching the arc core.

ARC WELDING MACHINE
A source of electrical energy with some means, generally automatic, of limiting the welding current within values suitable for welding.

ASBESTOS
A fibrous mineral. Withstands high temperatures. Low thermal conductivity. Highly resistant to action of acids. Used as a heat insulator and to some extent as an electric insulator.

"ARKWELD"
Trade name for protective helmet in arc welding. Made by Julius King Optical Co. New York City.

"ARMCO"
Trade name for iron welding rods and wire. Made by Page Steel & Wire Co., Grand Central Terminal, New York City

ASSOCIATIONS (WELDING)
International Acetylene Assn.; American Welding Society, Gas Products Assn., Compressed Gas Mfg.'s Assn., Brotherhood of Gas and Electric Welders and Operators of America. See "Associations," Table of Contents.

"ASTRA"
Trade name for an illuminating gas-oxygen motor pressure set. Made by Ashton, Laird & Co., New York City.

"ATLAS"
Trade name for goggles for oxy-acetylene welding and cutting. Made by Davis-Bournonville Co., Jersey City, N. J.

"ATLAS"
Trade name for gauntlet gloves for welders and cutters. Made by Davis-Bournonville Co., Jersey City, N. J.

"ATLAS"
Trade name for high silicon cast iron welding rods. Made by Atlas Foundry Co., Irvington, N. J.

ATMOSPHERE
Gas pressure unit. About 15 pounds per square inch.

ATOMIC WEIGHT
The determination of the weights of the elementary atoms in terms of anyone by the analysis of compounds. The weight of an atom of Hydrogen is taken as unity in preparing a system of atomic weights.

AUTOGENOUS
Meaning self created or generated. Explained in many encyclopedias under the term "Autogenesis," which is said to mean "I produce or generate." Autogenously, meaning spontaneously. It is plain that the word was first used to distinguish the present day advanced methods of welding from the older processes because it signifies the union of two sections of metal without the addition of some unlike metal, as is not true of braking, for instance. See Fusing.

"B-B-B"
Trade name for welding and cutting torches and regulators. Made by Bishop-Babcock-Becker Co., Cleveland, Ohio.

BACK FIRE
A torch backfires when the flame travels back through the torch into the handle, hose or regulator. It is caused by the ignition of an accumulation of mixed gases, due usually to poor manipulation of the cylinder valves, improper regulator adjustment, error in turning on and lighting gas, or dipping the torch tip into the molten metal. The backfire is accompanied by sharp detonations. The gases should be cut off at once at the stop valves or by bending the acetylene hose, which stops the internal combustion for want of fuel. Torch tip should be cooled and cleaned. See Flash Back.

BENDING TEST
When weld has cooled, place test piece in a vice in such a way that the line of the weld is just above the jaws of the vice. Hammer from opposite side of weld, so that the weld and added material will be in the folds of the bend. For pieces of ordinary sizes a twelve pound sledge is satisfactory and with a little practice welders can deliver hammer blows with almost uniform force and number of blows and degree of bend indicate character of weld. See Testing Welds.

"BERMO"
Trade name for welding, cutting, lead burning, de-carbonizing apparatus and fluxes. Made by Bertschy Mfg. & Eng. Co., Cedar Rapids, Ia.

"BERTSCHY"
Trade name for V-Blocks, Step blocks, trucks. Made by Bertschy Mfg. & Eng. Co., Cedar Rapids, Ia.

BEVEL
A weld properly prepared is a weld half completed. Indifferent beveling and poor preparation of parts to be welded is responsible for many failures. Popular opinion to the contrary, this disregard of an elementary principal of sound welding is most apt to occur in the case of an experienced welder, or at least an operator who has been welding for some time, rather than in the case of a beginner. The beginner quite naturally begins his welding education by carefully considering the first basic principal of the art, one of the first of which is thorough preparation. The operator who has been welding for some time and who has been encouraged by a degree of proficiency and success is more apt to grow careless and disregard some of his early training, with resulting failures. These failures he is often prone to attribute to anything but their true cause. So we deem it proper to not only caution the beginner to prepare his work carefully, but to also warn the older operator that no degree of proficiency in the manipulation of the tools of his trade will make him immune from the principal of good preparation of welds.
In preparing work to be welded the very

36

This is a composite page 1-4 actual size, made up to show the style of type and type page, variety of subjects treated, and method of treatment

PARTIAL CONTENTS:

Laws and the rules and regulations of the Insurance companies and their Inspection Bureaus; rules of the American Railway Association (M. C. B.), which tell you what you can weld on cars and locomotives, and also the rules of the Boiler Code Committee of The American Society of Mechanical Engineers. (These rules practically govern the welding of fired and unfired pressure vessels in America.)

Tables and charts of information about things the welder usually has to guess at. Melting points of metals, charts of Temperature Colors.

Last, but highly important, The Welding Encyclopedia will contain a mine of interesting information about American made welding and cutting apparatus, supplies and equipment, as used by American welders. The announcements of the leading manufacturers constitute a most complete catalog—something welders will value.

How to get a copy of The Welding Encyclopedia on Approval:—

THE Welding Encyclopedia will be ready for distribution January 1, 1921. We expect that the first edition of 5,000 copies will not last long. Readers of The Welding Engineer can get one of the first copies off the press by mailing the coupon at the bottom of the opposite page. Order with this coupon and a copy will be sent to you on approval. You keep the book five days and if it doesn't prove to be worth the purchase price send it back and we'll cancel the charge.

PUBLISHED BY

THE WELDING ENGINEER PUBLISHING CO.

608 South Dearborn Street CHICAGO, ILL.

Get Up in Front In Your Industry

HERE is a book written for the man who wants to know all about welding, for the man who wants to know what the other fellow is doing or can do. Descriptions and possibilities of the various forms of welding are set forth in detail, yet in language so simple that every man can readily read and understand it.

HUNDREDS of welders have already entered their orders for one of the first copies of THE WELDING ENCYCLOPEDIA. It is invaluable to them because they want to get "up in front." In welding, as in any other branch of industry, "The man who reads is the man who leads." Here is your chance to improve your welding knowledge, to equip yourself for handling intelligently any new problems that may arise in your work, to know beforehand what you can do and what you cannot do, to build your capacity and eliminate costly failures.

The Welding Encyclopedia Will Tell You:

The principles of all the various welding processes;

The applications of all the various welding processes;

How to make and how to test welds;

The definitions of hundreds of words and terms used in current literature on welding;

The characteristics of all metals that can be welded;

Where to go for all equipment and accessories used in the welding shop.

The answers to hundreds of questions that are not answered elsewhere.

This Coupon will bring you a copy of The Welding Encyclopedia on Approval

Order it Now.

The Welding Engineer Publishing Co.,
608 S. Dearborn St., Chicago, Ill.

Gentlemen:

I want one of the first copies of The Welding Encyclopedia. Please send me a copy as soon as it is off the press. I understand that I may keep it for five days for examination and I agree to send back the book or remit five dollars five days after receiving it.

Name .....

Street .....

Postoffice .....

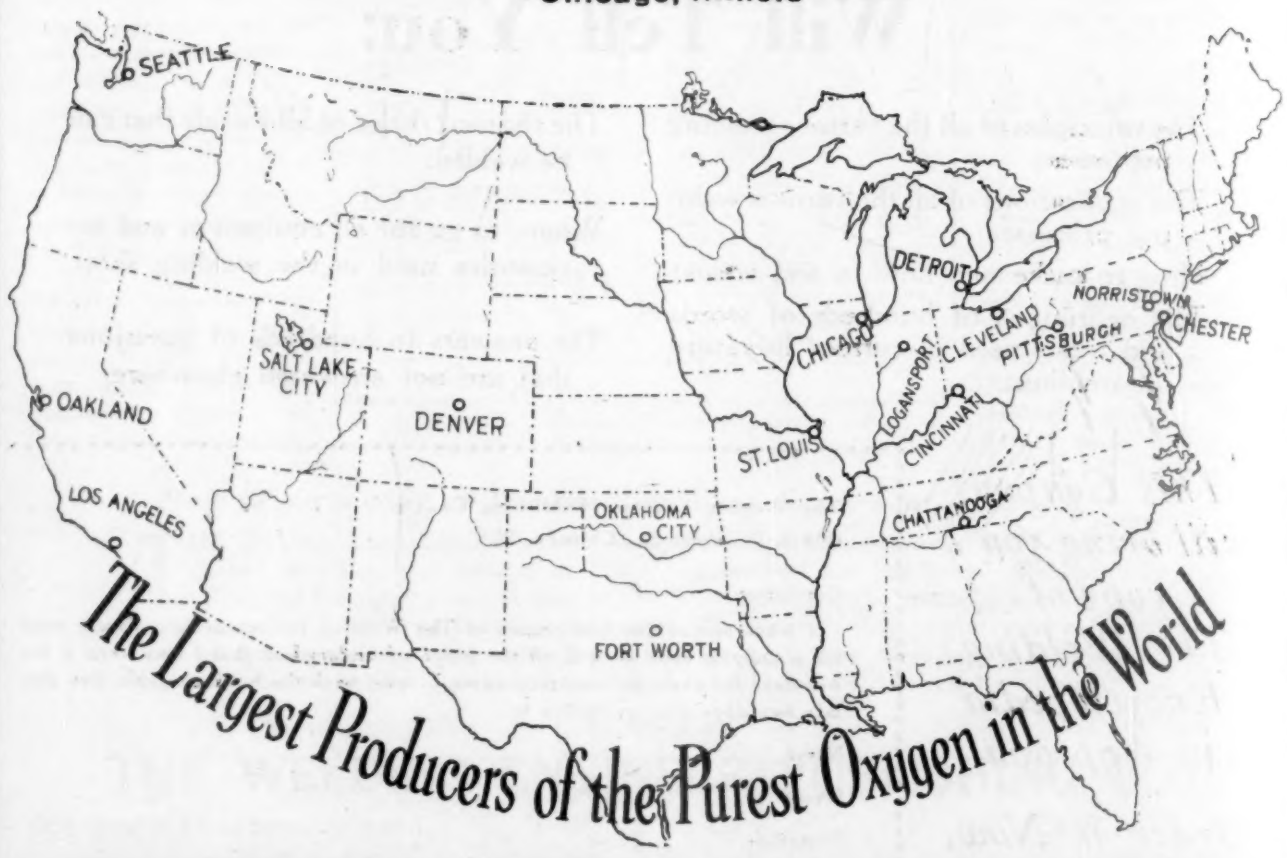
BURDETT OXYGEN COMPANY

AND ASSOCIATED COMPANIES

ELECTROLYTIC OXYGEN and HYDROGEN - 99 1/2 % Pure

Service from the following BURDETT PLANTS

Seattle, Wash.
Los Angeles, Cal.
Oakland, California
Salt Lake City, Utah
Denver, Colorado
Oklahoma City, Oklahoma
Fort Worth, Texas
St. Louis, Mo.
Chicago, Illinois
Detroit, Michigan
Logansport, Ind.
Chattanooga, Tenn.
Cincinnati, Ohio
Pittsburgh, Pa.
Chester, Pa.
Norristown, Pa.
Cleveland, Ohio



The Largest Producers of the Purest Oxygen in the World

"We guarantee to weld up your work at twice the speed and at one half the cost or you may return our welder for full credit."

This was the proposition we made one manufacturer.

We made good—he kept the welder.

Let us know what you are welding, and we might be able to make you a proposition which business judgment may force you to accept.

GIBB INSTRUMENT COMPANY

Factory and Offices: 348 Palmer Ave. E., DETROIT, MICH.

BETTER ARC WELDING

can be produced with

WANAMAKER COATED ELECTRODES

Because:—

They are of uniform density and homogeneous structure.

They deposit a pure, sound and very tough metal made possible by their effective and permanent coating.

They make possible the satisfactory welding of high carbon, medium carbon and special alloy steels.

They increase the efficiency of the operator.

COATED WANAMAKER ELECTRODES

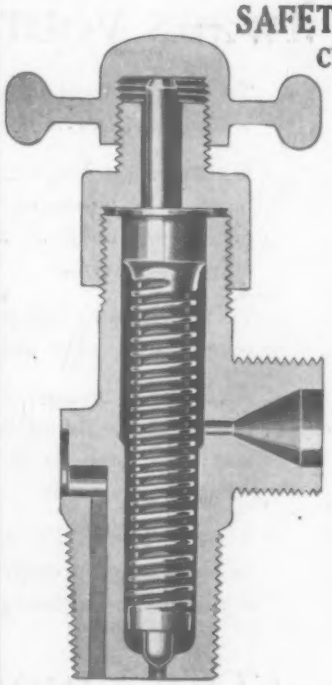
The Technically Correct Electrode

TRANSPORTATION ENGINEERING CORPORATION

200 Fifth Avenue
New York, N. Y.

608 S. Dearborn Street
Chicago, Ill.

SAFETY HIGH PRESSURE CYLINDER VALVE



A new principle in valve design developed for high pressure and proven in service.

Absolutely Tight Without Packing

LARGE REDUCTION IN MAINTENANCE COSTS, as it prevents leakage of cylinder contents in service or transit and prevents return of filled cylinders because valves cannot be opened.

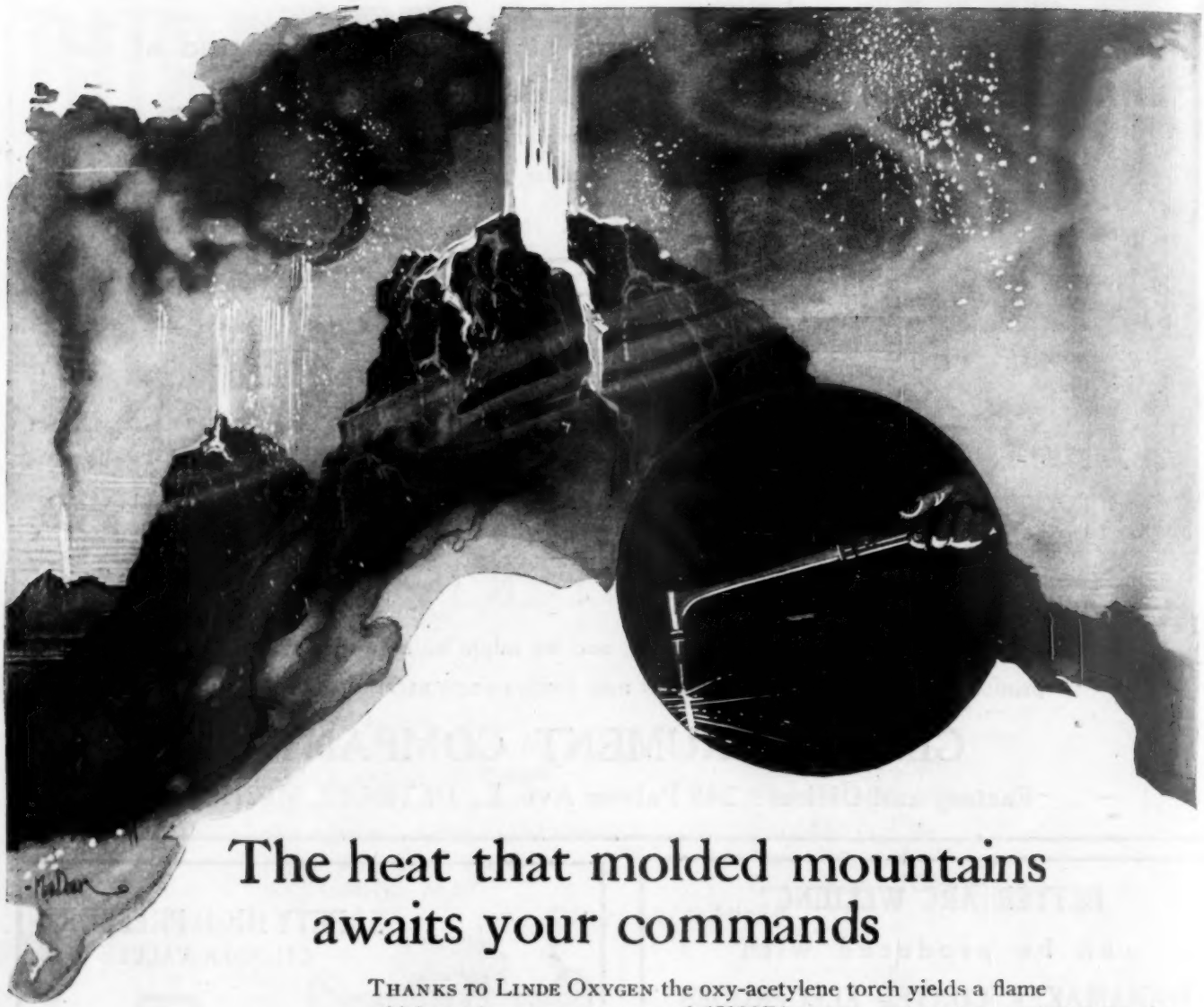
Body of very dense metal to secure strength and non-porosity.

Fusible plug, approved by the Bureau of Explosives.

Minimum parts. Maximum sturdiness.

THE SAFETY CAR HEATING AND LIGHTING CO.

New York Chicago St. Louis Philadelphia
Boston San Francisco Montreal Mexico City



The heat that molded mountains awaits your commands

THANKS TO LINDE OXYGEN the oxy-acetylene torch yields a flame which reaches a temperature of 6500°F!

UNDER SUCH HEAT as this the most stubborn of metals is readily handled by workmen of intelligence—and better, quicker, easier production methods are daily replacing the clumsy and costly ways of yesterday.

UNTIL LINDE industrialized oxygen, such terrific heights of temperature were unknown outside of the laboratory.

AND NOW, because of Linde researches, and Linde enterprise this world building heat, harnessed and controlled by the oxy-acetylene torch, is at your service in your own shop when and where you want it.

THIRTY LINDE PLANTS and forty-two centrally situated warehouses insure prompt delivery anywhere of highly pure oxygen in any needed quantity.

LINDE OXYGEN,
PRODUCT OF THE AGES,
IS OBTAINABLE PROMPTLY—
ANYWHERE AT ANY TIME

THE LINDE AIR PRODUCTS CO.

THE LARGEST PRODUCERS OF OXYGEN IN THE WORLD

CARBIDE and CARBON BUILDING, 30 EAST 42ND ST., NEW YORK

KOHL BUILDING ❦ ❦ ❦ SAN FRANCISCO

L-518

PROCEEDINGS *of the* AMERICAN WELDING SOCIETY

33 West 39th Street, New York

Officers and Committee Chairmen
AMERICAN WELDING SOCIETY
1920—1921

J. H. Deppeler, President
C. A. Adams, Junior Past President
J. W. Owens, Vice-President
D. B. Rushmore, Vice-President
W. E. Symons, Treasurer
M. M. Kelly, Acting Secretary
J. H. Deppeler, Chairman Executive Committee.
W. E. Symons, Chairman Finance Committee.
Hermann Lemp, Chairman Committee to revise Constitution and By-Laws.
C. A. McCune, Chairman Membership Committee.
Edward A. Miller, Chairman Meetings and Papers Committee.
A. S. Kinsey, Chairman, Welding Conference Committee.

THE METAL ARC WELDED BATTLE TOWING TARGET BUILT AT THE NORFOLK NAVY YARD†

By
James W. Owens* and H. G. Knox**

Introduction:

THE welding of Battle Towing Target No. 60 was authorized by The Bureau of Construction and Repair of the Navy for the following reasons:

(a) To determine the suitability for ship construction of various types and forms of arc welded joints.
(b) To gain experience on the welding of a large structure by the metal arc.
(c) To observe the behavior of various types of arc welded joints under sea-going conditions.

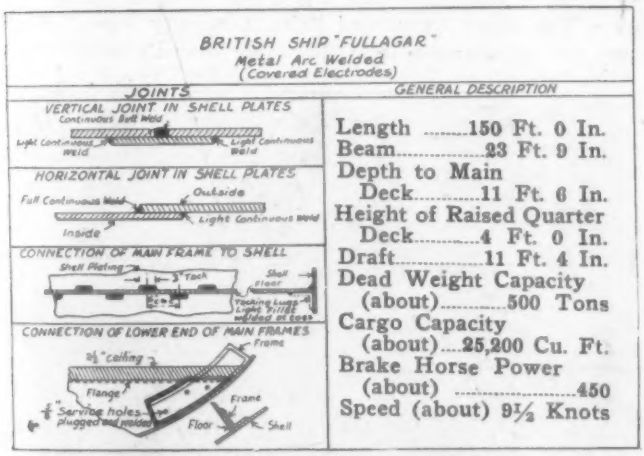


Fig. 1. Types of Joints Used in the "Fullagar".

In shipbuilding the use of arc welding has up to quite recently been confined to the welding of minor parts and in repair work. In the latter field, particularly, it has shown advantages peculiar to itself. In the corection of discrepancies incident to the assembly of the fabricated ship it has become a necessity and is now used extensively in this connection.

†*Paper presented before the Metropolitan Section of the American Welding Society, October 25, 1920.*

**Welding aid and assitsant shop superintendent United States Navy Yard, Norfolk, Va., and vice-president American Welding Society.*

***Manufacturing engineer, The Winchester Arms Co., New Haven, Conn., formerly commander C. C., U. S. N., shop superintendent Norfolk Navy Yard.*

Contemporary Construction:

Before the construction of Target No. 60 was undertaken, there had been welded in America, on one of the Great Lakes, a 42 foot job welding launch. A description of this launch is to be found in the General Electric Review of December, 1918.

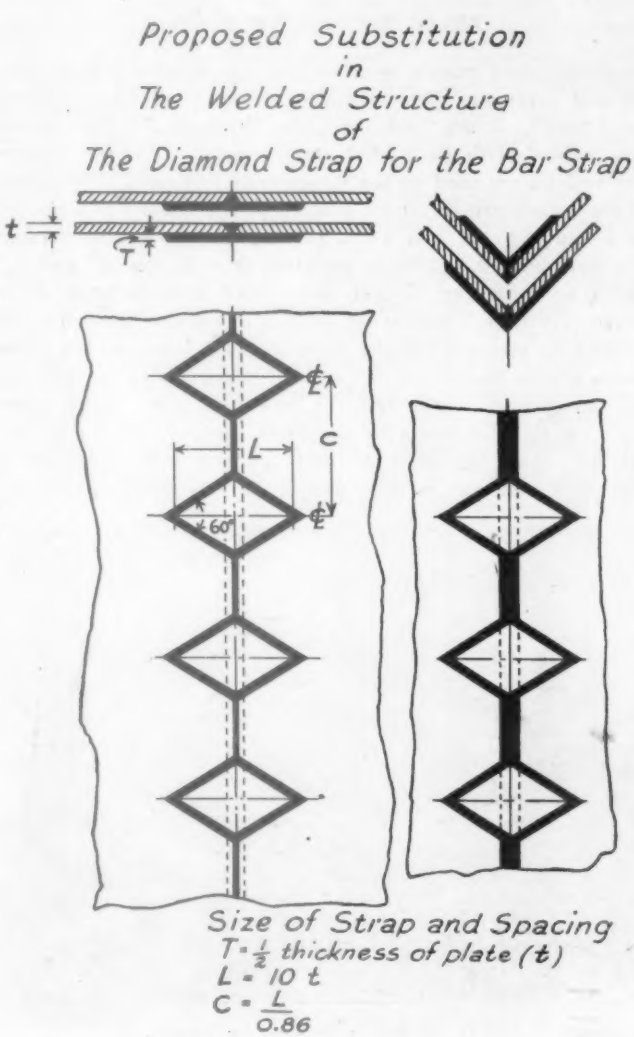


Fig. 2. The Diamond Strap.

On August 10th, 1919, there was launched in England a

125 ft., 275 ton Cross Channel Barge, which has since been in continuous service.

On June 29th of this year, (1920) an all welded 500 ton coastwise steamer, the "Fullagar," made its maiden trip from the Mersey to the Clyde. During this trip she encountered very rough weather but the welded joints stood the test perfectly. The following facts are of interest about the Launch, Barge and the ship "Fullagar." The launch was welded with bare mild steel electrodes, while covered electrodes were used on the Barge and "Fullagar." The plates of the launch are $\frac{5}{16}$" thick, riveted to the frames and jointed by a double-bevel butt weld. Plates of this weight present relatively less of a welding problem than do the $\frac{3}{8}$" and $\frac{1}{2}$" plates used in the Target and other constructions mentioned. With $\frac{5}{16}$" plates not only is assembly easier but the "locked up stresses" in the weld are of a lower order. The plates of the Barge are $\frac{3}{8}$" and $\frac{1}{2}$" thick and a joggled lap was extensively employed. Continuous fillet welds were made on the lap joints of the bilge plates, both inside and outside. The lap joint of shell plating had continuous fillet weld on the outside and a 3" intermittent weld 6" C to C on the inside. Intermittent welding was employed for all non-watertight joints of bulkheads and frame construction. 245 man-hours and 45 tons of metal were saved in its construction by welding instead of riveting. The cost of the welding and riveted constructions were about the same, but on future work it should be possible to effect a saving by welding.

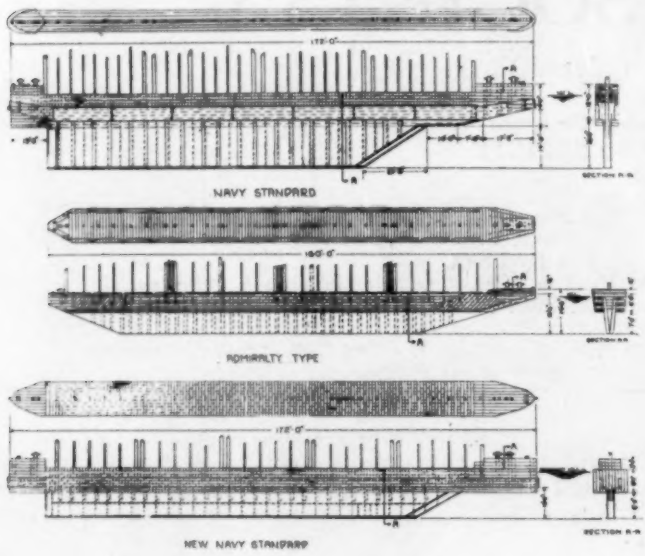


Fig. 3. New Navy Type Target.

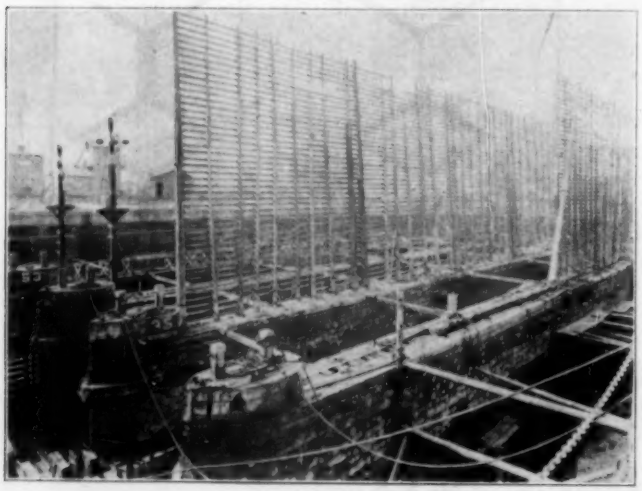


Fig. 4. Targets in Drydock for Repairs.

Fig. 1 shows the various types and forms of joints used in the "Fullagar." It is interesting to note that not a rivet was used in the construction of this ship. Rivets could no doubt have been used to advantage for many connections, but it was decided to entirely eliminate their use.

The Target:

A Battle Towing Target consists of three principal parts:

(a) The steel keel section.

(b) The wooden superstructure.

Fig. 5. Starboard Upper Section Being Assembled.

(c) The masts, rigging and screen.

The Keel Section is of non-watertight steel construction and carries the ballast required to keep it on an even keel.

There are two types of Targets, or to be more specific two types of keel section, in use in the Navy at the present time—"The Navy Type" and "The Admiralty Type." Both types are of approximately the same over-all length: 172 feet and similarly rigged but differing in beam and draft, the Navy Type being of narrower beam and of deeper draft.

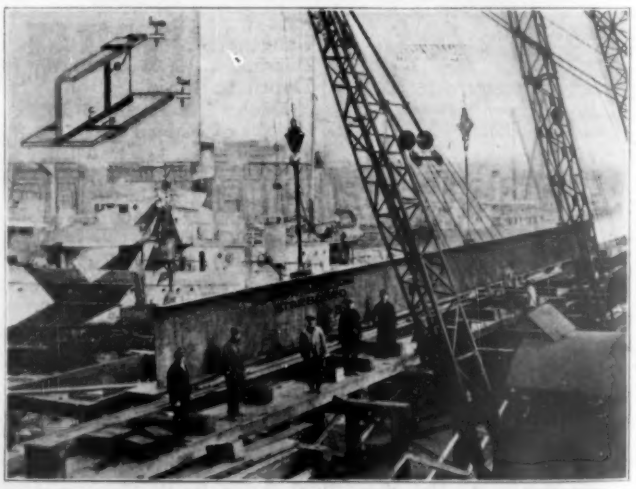


Fig. 6. Turning Over Upper Sections to Permit Welding "B" and "C" on the Under Side.

A composite type is being built at the present time and is known as **The New Navy Type.** Fig. 3 shows the outlines of these three types.

The arc welded target is of the old navy type and the steel used in its construction weighs 45 tons.

The Wooden Superstructure, on which the buoyancy of the target depends, is constructed of fir timbers 12 inches

square which are thoroughly interlaced both longitudinally and transversely to give rigidity. The timbers are secured by 1¼ inch bolts which pass through drilled holes in the upper section of the steel keel. Some of the bolts are 9 ft. long. The weight of the wood is approximately 211 tons.

The masts are 12″x12″ and 12″x3″, and carry the rigging and screens necessary for practice. The masts and rigging are clearly seen in Fig. 4, which shows four targets in Dry Dock for repairs.

A 9 inch manila hawser is used in towing. During Division practice the target is towed about 40 yards from the stern of the tug. It is not intended that the shots shall

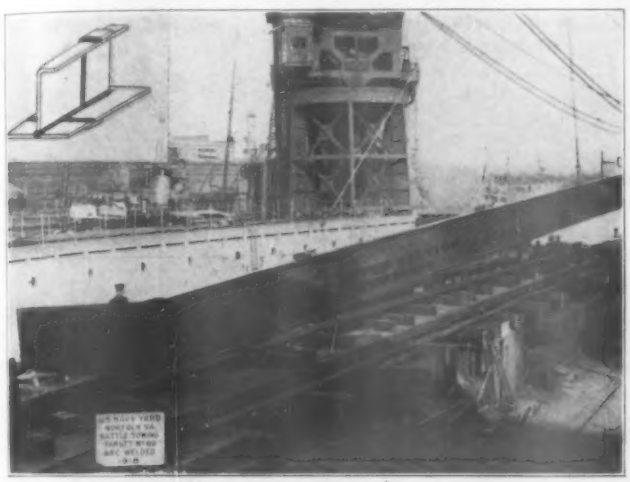


Fig. 7. Completely Welded Starboard Upper Section.

hit the steel keel section or the wooden superstructure, nevertheless this frequently happens as is shown at A, B, C, Fig. 4.

When actual welding was undertaken unforeseen problems of handling, imperfectly trained welders, etc., necessitated changes, both in joint design and welding sequence as planned.

As the welders used had, in a very few cases more than

Fig. 8. A Crack Due to Locked-up Stresses.

three months experience and this acquired, in large part, by observation, it was decided that regardless of design, that all sections should be so assembled as to permit "flat" welding whenever possible. Some vertical and overhead welding was also done. It is estimated that the linear feet of welding in the various positions is in the following proportions: Flat 4024 ft., horizontal 16 ft., vertical 400 ft., overhead 600 ft., making a total of 5,040 ft. Due to urgent repair work, scarcity of men, machines, problems of power supply, and weather conditions, the target stood days and weeks at a time with no progress being made.

The following forms of joint were used: lap, single-bevel tee, double-bevel tee, double-bevel butt, and double-bevel butt strap.

The "rigid" type of joint was used exclusively except in one case, which will be pointed out later.

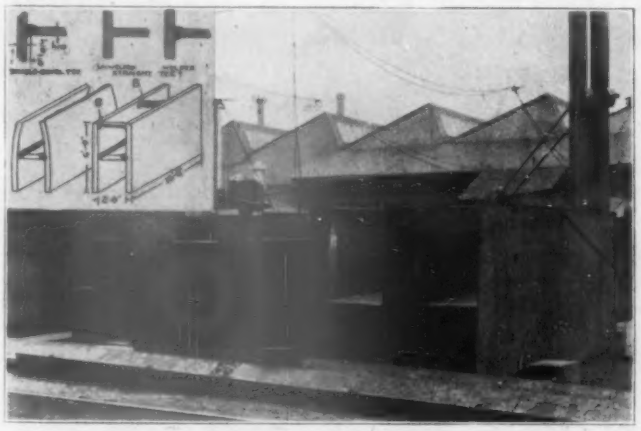


Fig. 9. Cellular Keel Sections Assembled for Welding.

There are a series of manholes 2 ft. square on the side. Through these are handled the ballast required for stability. Tap bolts used to fasten the manhole cover plates are the only bolts used in the metal part of the completed target.

In preparing joints for assembly ½″ holes were drilled 3 to 5 ft. apart in the plates adjacent to the joint and suitable flat or angle clips used in bolting up. These clips were gradually removed as welding progressed. The holes were not filled up, for as pointed out, the keel is of non-watertight construction.

Shipfitters, chippers, riggers and helpers were used to assemble the job, the welders being required only to clean the joints and weld.

One of the first things an apprentice shipfitter is taught is to bolt two surfaces securely together. As is known, the assembly of several forms of joint require for welding a space ⅛″ or $\frac{3}{16}$″ to be left between plate edges. When experienced shipfitters are employed on this work, it is found that as this practice is at variance with their accepted standards of a good job, a problem of no small difficulty has to be overcome. From the foregoing, it would appear that for welded ship construction, the shipfitter in addition to the welder, will have to be carefully trained to the modification in methods.

⅛″ and $\frac{5}{32}$″ bare mild steel electrodes were used, the

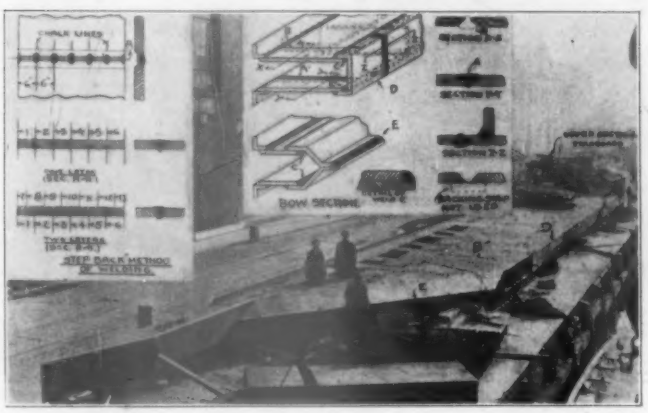


Fig. 10. Keel Sections Prepared For Welding.

analysis of which complied with the specifications of the American Welding Society.

The ⅛″ electrode was used almost exclusively at first;

but when the target was about 50% completed the use of 3/32" and 1/16" sizes was increased. The average current used on all joints was 135 to 150 amperes. All straps were welded with one continuous full fillet weld on each edge. Both one

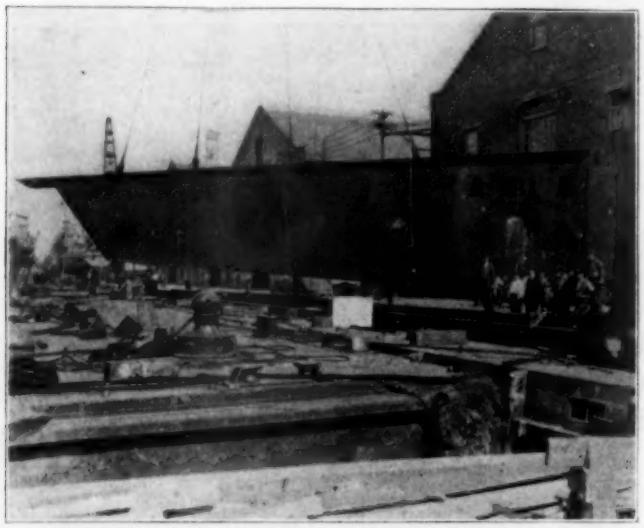


Fig. 11. Lower Keel Section Turned Over to Avoid Overhead Welding.

and two layers were used on the tee and butt joints depending on experiment and judgment. In the tee joints the layers were continuous, while on all double bevel butt joints, except the first ones welded, the "step-back" welding sequence illustrated later was used. In some of the first butts welded, no specific welding sequence was adhered to; this, together with the fact that the tacks were spaced at too great intervals, namely, 12 to 18 inches apart, resulted in some cracked welds. In double bevel butt strap joints, the strap edges were in the early stages of construction, welded before the butt. This welding sequence concentrated the "locked up stresses" between strap edges, resulting in a prohibitive increase in their magnitude. This was one of the causes of premature joint failure.

Fig. 5 shows the starboard upper section being assembled for welding, and the sketch illustrates the types of joints used. The straps "A", (not yet assembled in the figure), were first welded; then butt "B"; next side "C" of double

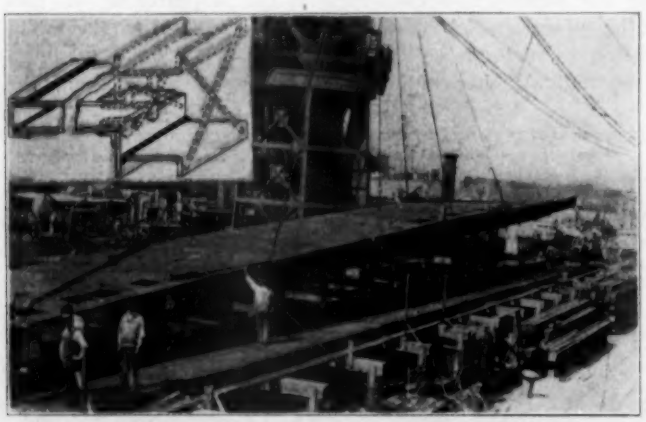


Fig. 12. Lower Keel Section on Wooden Framework.

bevel tee. In order to facilitate handling, joint "D" was not welded.

Fig. 6 shows the two starboard upper sections being turned over by three 50 ton locomotive cranes, to permit welding of "B" and "C" on the underside.

After welding, cracks developed in some of the horizontal and vertical butt welds "B" of the double bevel strap joints. Some of these cracks were 3 and 4 ft. long, and were due to the causes previously enumerated. In overcoming this difficulty, the weld on one side of the strap was never chipped out. However, the tendency to crack was apparently overcome by using the "step-back" welding sequence for the butt joint. This, however, was not accomplished until after the weld metal had been chipped out and the joint properly tacked.

Fig. 7 shows the completely welded starboard upper section, illustrated in Figs. 5 and 6. The section was lowered to the ground by the 150 ton floating crane and each joint tested, both on the butt and strap sides by blows from a 16-lb. sledge.

Fig. 8 shows the only crack that developed and this was at joint "D" on which the strap had not been welded when

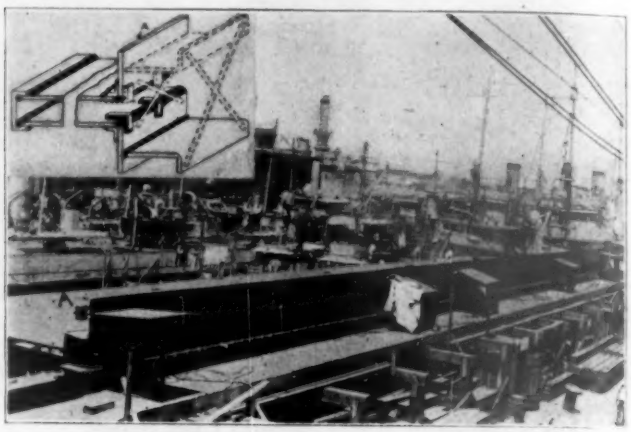


Fig. 13. How Screens Are Used to Protect Welders.

the joint was tested. The crack was evidently due to the "locked up stresses," as it was in the center of the weld showing that good fusion had been secured at the base metal.

Fig. 9 shows the cellular keel sections assembled for welding. The sections were constructed of two 3/8" plates, 16

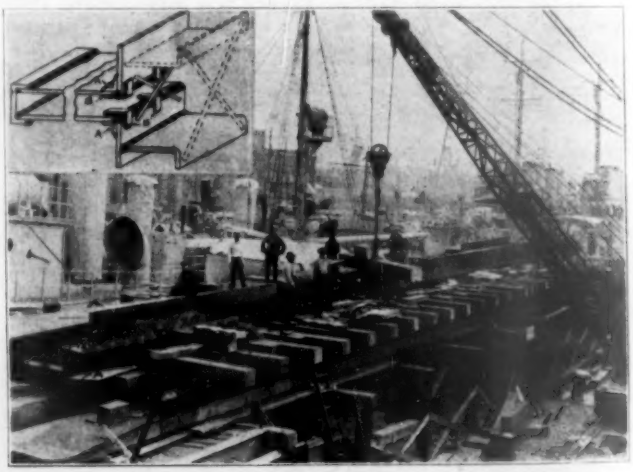


Fig. 14. Method of Assembling Superstructure.

ft. long by 6 ft. wide, spaced 2 ft. apart by one or two separating plates or "floors." These floors were also of 3/8" metal, and were welded to the two side plates by a single bevel tee joint shown in the sketch, two layers being used.

The contraction of the weld metal caused the plates to bend inwards as illustrated in the sketch, necessitating the use of spacers "B", four feet apart.

Two layers of metal were necessary in this joint because a comparatively low current had to be used to avoid the burning away of too much of the thin knife edge of the

floors. This current was hardly high enough to obtain good penetration in the sides, which shows that the single bevel form of tee joint is not very satisfactory. The straight tee shown in the sketch, using a high current and a full, continuous weld on each side, would be much better.

When all the floors had been welded, the keel sections were laid side by side and bolted up preparatory to welding, as illustrated in Fig. 10.

The welding of the 16 foot butt joints "A" on the starboard or bottom side was commenced at the stern. Trouble was experienced with cracked welds, in the first three or four joints, however, this difficulty was overcome after the two layer step-back sequence was used.

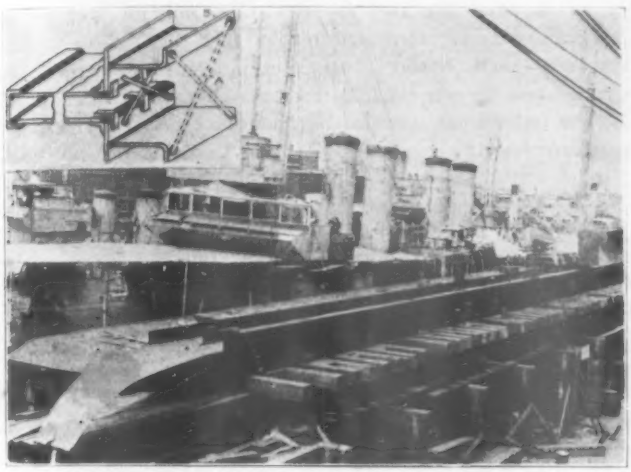


Fig. 15. Completed Keel Section.

The butt welds "B" on the port or top side were welded by the one layer step-back sequence, but not until the section had been turned over. The one and two layer step-back sequence were used for comparison. All the remaining

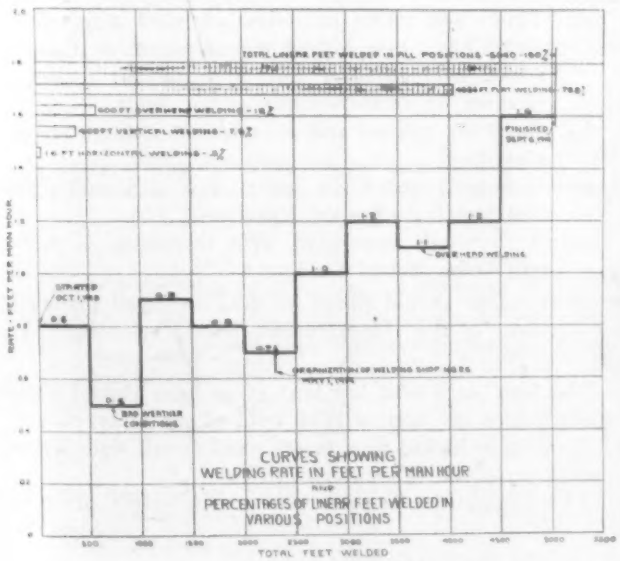


Fig. 16. Progress Chart.

flat and vertical joints (lap and tee) were also welded while the keel was in this position. Joint "C" was of poor design, being difficult to weld and requiring a large amount of electrode material.

Every butt joint was tested with a 16 lb. sledge and the only ones that cracked were the first ones welded in which no proper sequence was used. One vertical weld in the bottom plate "D" also cracked when the section was being turned over, but this was also due to an improper welding sequence.

The Step-Back Welding Sequence As Employed.

The preparation of the joint being of prime importance, the location of the tacks was chalked off by a series of lines

Fig. 17. Launching the Target.

spaced 6 in. apart the entire length of seam. Small tacks were used which were one-half the thickness of the material and one-half inch long, care being used to obtain good fusion as tacks were never chipped out. In order to avoid the inevitable closing in of the seam in the direction in which the tacks were being made, they were spaced widely apart and in random locations to overcome this difficulty. In long seams, a definite sequence of tack location should be considered.

Welding was started at one end of the seam and sequence shown in sketch adhered to. Chalk marks facilitate the commencing of each step of the second layer, midway between tacks. These can therefore be dispensed with when only one layer is used.

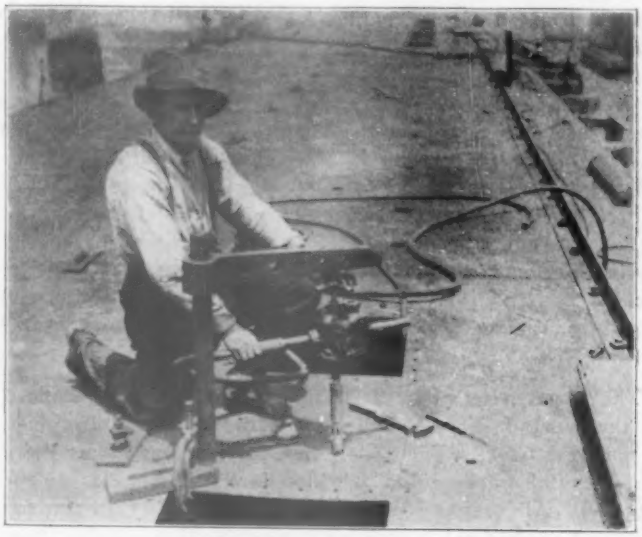


Fig. 18. Removing a Specimen for Test.

With the two layer sequence, a more uniform cross section fusion is secured, but if a "backing strip" shown in sketch is used, the percentage of cross sectional fusion would have been the same in both the one and two layers.

Fig. 11 shows the lower keel section turned over to avoid overhead welding. The welding of this section having been completed, it was lifted horizontally by the 150 ton crane, and placed on the wooden framework for welding to the upper section, the starboard one of these having been completed as shown in Fig. 12.

In view of the trouble experienced in welding the butt strap joints of the upper starboard keel section, all the butts, in the upper port keel section were welded first, both the rigid and semi-rigid sequence being used.

Butt joints in plate "A" Fig. 13 were welded in three sections on the ground with a semi-rigid type of joint, and assembled as shown. After assembly, the rigid type of joint was used to join these three sections.

This figure shows the use of screens for the protection of the welders. Strong air currents are at times very annoying to the welder, making it very difficult to hold the arc. Small camp stools and padded mats were furnished. Direct current was used exclusively for welding and the one operator machines were housed in booths built for this purpose, under the wooden structure.

A single operator gas engine driven machine is shown in the foreground. Lack of electric power available at this point necessitated the use of this machine.

The drawing of the target as designed does not show the continuous 3½"x3½" angles "A", nor the 6"x4½" angle clips "B" shown in Fig. 14, for it was afterwards considered that this joint would be subjected to severe alternating bending stresses under seagoing conditions and these angles were added to reinforce it. Angles "A" also served the purpose of improving the design of joint, as the top welding edge of the lower keel section was very irregular. In this figure is shown the interlacing of the timbers of the superstructure and method of assembly.

Fig. 15 shows the completed steel keel section with the exception of the straps "A", shown in sketch.

Flange section "B" was welded in three sections using by the rigid type of joint, the butts first, then the straps, and assembled as shown in the figure. Due to its flanged construction, the non-rigid type of joint was not feasible for use on the butt joint.

The progress of welding was recorded daily on a chart, copies of which were posted on the job and in the main office. Fig. 16 shows welding rates during construction for successive increments of 500 feet.

The improvement in the welding speed of the imperfectly trained operators is quite marked. Other causes affecting speed are also noted on the chart. The increase of speed due to closer supervision is clearly shown and this is one of the factors to which careful attention should be given if welding is to compete successfully against riveting.

Fig. 17 shows the launching. This event was marred by having one end of the target lag. Perhaps fate tested the welded construction. At any rate, the welds held and the first Arc Welded Target was a decided success.

Service Test:

The target, after about a six months service test, returned to the Norfolk Yard. It had been towed to the Bermuda Island and back. When examined, it was found that there were several cracks about 12" long in the butt welds of the fin keel. All cracks were located near the bottom of the keel and their total length was approximtaely 10 to 15 ft.

Apart from these cracks, the structure was in perfect condition. Cracks were evidently due to the fact that the flanged bottom plate was welded before the butt joints "A" & "B" Fig. 10. This welding sequence resulted in high locked up stresses in these joints adjacent to the bottom plate.

Tests Applied:

Several references have been made to the use of the Blow Test and Fig. 8 shows the effectiveness of this test.

There was also developed and tested out on this job a new method of testing the weld. By this test, an idea can be obtained of the degree of fusion, and quality of the weld metal.

It consists of cutting out a ring shaped section from the weld, then obtaining its tensile strength and ductility by means of suitable equipment. Fig. 18 shows a mechanic removing a specimen for test. Five specimens were cut from the butt joints on each side of the fin keel. The test showed that the one layer weld had a tensile strength of 37,500 lbs. per sq. in. and the two layer weld 41,000 lbs. per sq. in. This difference is attributed to the fact that as no backing strip was used, better cross sectional fusion was secured with the two layer weld than the one layer. With the trained welders (which are now in the Norfolk Navy Yard) and improved technique, these figures could be decidedly improved.

Costs:

The cost of this target was considerably more than that of a riveted one, but this was to be expected on account of the unfavorable circumstances under which it was built and the types of joint used.

It is estimated that there should be a saving of at least $4,500.00 on a welded target of this type if:

(a) Plates are ordered neat.
(b) If bare electrodes are used.
(c) Lap joints are used in the place of butt joints.
(d) Intermittent welds are used when suitable.
(e) Experienced welders are used.
(f) Built under the supervision of a well organized welding shop.

Conclusions:

1. Metal arc welding has a very promising future in ship construction provided:
   (a) Types and forms of joints are used which inherently have low locked up stresses, or those in which compensation can be made for locked up stresses by reinforcement of the joint.
   (b) Carefully trained and experienced welders are employed.
   (c) It is built under the supervision of a well organized welding shop or department.
   (d) A thorough system of weld inspection is carried out during actual welding.

2. Butt joints should never be used for shell plating or other sections of the ship structure unless reinforced by a strap.

3. The butt weld of a bar butt strap joint should always be made before the second fillet weld of the strap.

4. No fear of locked up stresses need be felt with lap and tee joints in ½" or ⅝" material.

5. The straight tee is preferable to the single bevel and single vee tee as it saves cost of machining and provides ideal thermal characteristics.

6. A backing strip should always be used when welding joints in which there is a possibility of imperfect cross sectional fusion without its use.

7. Preliminary tests indicate that the diamond strap, Fig. 2, would in a large number of cases, be an improvement on the bar strap. Its use would materially reduce the weight of the strap and thus the structure.

For announcement of the December meeting of the American Welding Society, Chicago Section, see page 32.

EFFICIENCY OF OXY-ACETYLENE WELDING

By BENJAMIN HEYMAN
Philadelphia Cutting, Welding and Brazing Co.

IT is very interesting to note the varied arguments which the average shop superintendent or plant manager offers when approached by the solicitor of a job welding shop. Many times it takes the form of "we have our own outfit for welding" or "we have sent out work but have never had satisfactory results." At other times, and they are numerous, the solicitor is welcomed with open arms to help solve some difficult problem. Either shipment is delayed due to faulty castings which cannot be replaced, or some error in machining has spoiled the part, or it may be a bad break down of machinery with resultant loss of production until repairs have been completed.

Between these two extremes are innumerable other possibilities. But it is safe to say that back of this state of affairs there are good, sound reasons.

In the first case we have the result of sales propaganda by some of the oxy-acetylene apparatus manufacturers. It is the simple statement to the executive in charge of a plant that "the repair of one expensive machine part will pay for the entire welding outfit." True enough, but not the whole truth. No consideration is given the fact that welding apparatus is valuable only in the hands of an experienced operator. And an experienced operator commands a high rate of pay. When such an operator works only at intervals he may be classed as overhead, unless the repairs he makes are actually valuable. Of course, when the welder may be used on other tasks the problem simplifies itself, excepting, that a welder loses his ability to a great extent by failure to work continually at his calling.

On the other hand, if the welder is of the "1918 model" or

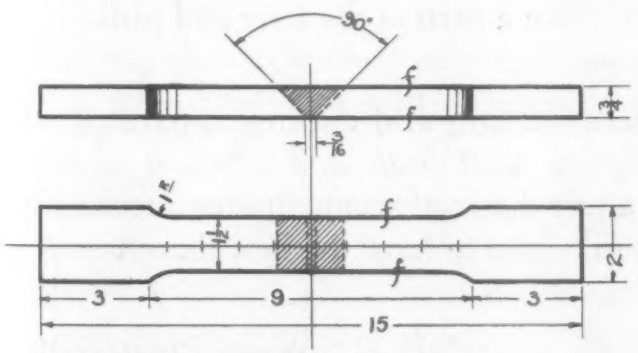


Fig. 1.

"sheet metal variety" who knows how to plaster the filling rod over a bad break and smooth it over to produce a neat piece of work, we need express no surprise at the impression which is produced when the so-called repair becomes a catastrophe.

Where poor results have been obtained by sending out work, we may look for causes similar to the one in the last paragraph. The average job welder has perhaps worked in a repair shop under proper supervision for a time, or in some large plant at a line of work in which he has become proficient. He has picked up a limited amount of skill and perhaps a slight knowledge of metals. He opens a small shop, advertises, and obtains work. Usually he becomes bewildered by the assortment of problems which he must handle. He takes risks. The inevitable results. Some of the work opens after a short term of service. The use of improper methods and materials results in strains and structures of such nature that machining is practically impossible. No wonder the art has been given such a black eye!

And it is a well established fact in oxy-acetylene welding practice, that a weld can be made just as sound and durable and easy to machine as the original metal. The question of hardness depends chiefly upon the use of materials of the right composition and the employment of proper methods. Further than this we will not discuss this question, as we are chiefly concerned in this article in the tensile strength and ductility.

When an inexperienced operator is employed the range of results is surprising. So many variables enter into and affect a weld that slight ignorance of any one or more causes disastrous results.

The efficiency of a weld is ordinarily understood as the ratio of the ultimate strength of the welded sectional area to the ultimate strength of an equivalent unwelded specimen of similar material. The value of this ratio has been well established, through many years of careful observation on a wide range of materials, as averaging between 85 and 90 per cent.

It must be understood, however, that such an effciency can be expected only from an operator who knows how to control the many variables that were mentioned previously. He must know how to manipulate a torch properly and understand flame compositions and intensities and their effects under all conditions upon all classes of work. He must have a broad knowledge of metals, their properties and tendencies under all temperate conditions, (just how each is affected by such

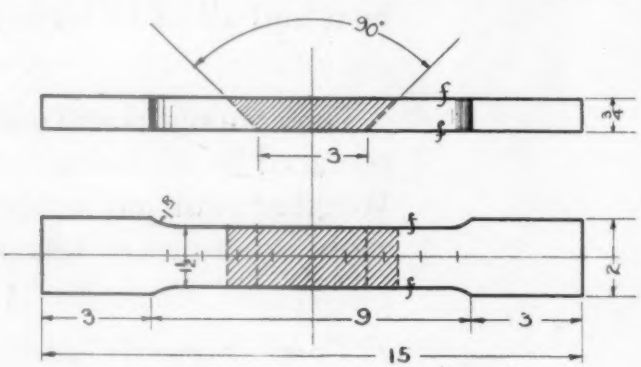


Fig. 2.

strains as are caused by contraction and expansion). He must have materials of the proper composition—fluxes, filling rods, etc. But most important of all, he must be familiar with the methods which are best adapted to each class of work, that is, setting up, preheating, annealing, etc., so that proper fusion may be attained and the welded part protected through the entire process, until it emerges cold and finished.

Tensile strength is the question uppermost in our minds, as it is the one which becomes readily apparent. The success f a weld generally depends upon whether it holds or not. It is the most convincing argument to the layman as it is the the one which he can readily grasp and to which there is no answer.

WELDING AND CU

Back To Normal

Conditions which follow every war are with us. The re-adjustment period is here with a bang. It came sooner than we all expected it, but it had to come and *it's going to do all of us a lot of good.*

There isn't anything to worry about. We've all got to work a little harder, buy more carefully, *plan more thoughtfully,* do better work and be cheerful.

Inefficient and uneconomical ideas must give way to efficient and economical ones. Hap-hazard, happy-go-lucky methods of buying or selling, of planning or executing are gone. We're all of us in the same boat and all of us have got to take a turn at the oars and pull.

Uneconomical and inefficient welding and cutting apparatus will be replaced by *technically designed, well built and efficient equipment.* Whether your job is that of a purchasing agent, master mechanic, job shop owner or a welder, it is up to you to have the best there is.

Torches poorly designed are wasteful in oxygen, materially increasing your oxygen bills without sense or reason. They waste the time of your welders with flashbacks. They deposit oxides in the weld, causing it to be hard and brittle instead of soft and ductile.

THE BASTIAN B
WEST AUSTIN AVENUE

TING APPARATUS

There is going to be a lot more attention paid by all of us to principles of welding apparatus construction — sound, logical engineering facts—starting right now. *We are going to dig into the whys and wherefores* rather than accept misleading advertising or salesmen's propaganda.

In this re-adjustment period REGO equipment and REGO jobbers will be prepared to *really serve you.* We are prepared to demonstrate and *prove* that REGO equipment is efficient and economical to a degree not thought possible before the invention of the REGO principle of gas mixture. Neither we nor our jobbers want or expect you to accept any statement as proof. *All of us are anxious to actually prove* in your plant our claims—that *REGO torches use less oxygen; operate on lower pressures; eliminate flashback and make better welds.*

REGO equipment is essentially and primarily economical equipment, its first cost is reasonable and its upkeep is amazingly low.

If you are interested—and you must be in these times—in lowering costs and improving the quality of the weld, we stand ready to help you through our national chain of distributors, all of whom are men versed in the welding and cutting art and with the knowledge to solve your practical, as well as your engineering problems.

Catalogue and literature upon request.

SSING COMPANY
LA SALLE STREET CHICAGO.

But to those interested in the art, there are other features of unquestionable importance, and one of these, ductility, will now be considered. It certainly is essential to know just what occurs to metal which has been subjected to high temperature flames when strains are put upon it in actual practice.

In the case of tensile strength almost any value can be produced by a skilled welder using proper materials and methods if he is not limited in the amount of material which he may add. By building up the broken cross section so that it exceeds the area of the original material any value over 100 per cent can be obtained. It is not unusual to have machine parts that have been welded and put under abnormal strains break at distances away from the weld without the repair suffering in any way.

During a discussion at an important welding association meeting about a year ago, the statement was made that ductility of welded specimens could not be measured owing to the value of such ductility being very small. Reasons were not forthcoming, but it developed during the discussion that in the case of mild steel an elongation of 10 to 12 per cent in 2 inches had been attained. The suggestion was then made that where rupture occurred in the weld the break occurred at a point so close to the elastic limit that no apparent stretch could occur.

Shortly after this the writer performed a series of tests on mild steel plate to verify this fact, and some interesting results were obtained. The tests were not complete in every way due to lack of proper apparatus; no readings were taken of the elastic limit, but the figures noted were of such character as to cause surprise.

Welds were made by experienced men under identically similar conditions. Standard analysis rods were used as supplied by a large oxy-acetylene manufacturer. The only difference that could be allowed for was that of the human factor, in so far as skill was concerned.

The size and shape of test bar in the first series of tests is shown in figure 1. Specimens of the unwelded material were machined and tested to obtain average tensile strength, elongation, and reduction in area. The values obtained are given in Table I.

Table I.

Specimen No.	Ultimate Strength Lbs. Per Sq. In.	Elongation Per Cent In 2 Ins.	Reduction In Area Per Cent
1	58,200	49.5	52.8
2	58,600	48.5	52.6

The welded specimens were also machined. The method of welding is indicated by the shaded portion and represents the usual way of adding filling material. The results obtained are given in Table II. The weld efficiency was calculated as:

$$\frac{\text{Ultimate strength welded material in pounds per square inches;}}{\text{ultimate strength unwelded material in pounds per square inches.}}$$

For the denominator of the above ratio the average of the ultimate strength in Table I was used (58,400 pounds per square inch).

Table II.

Specimen No.	Ultimate Strength Lbs. Per Sq. In.	Elongation Per Cent In 2 Ins.	Reduction In Area Per Cent	Weld Efficiency Per Cent
1	51,800	20	18.6	88.6
2	47,900	17	22	82
3	50,000	14	5.8	85.6
4	52,800	12.5	12.4	90.5
5	47,800	13.5	17.4	81.8
6	48,760	15.5	23.4	83.5
7	45,100	8.5	9.8	77.2
8	46,400	10.5	10.4	79.4
9	37,700	10.5	15	64.5
10	50,200	15.5	22.5	85.9

The second series of tests consisted in subjecting to tensile strains a set of coupons welded as shown in Fig. 2. As will be noted the central or shaded portion is made up entirely of filling material.

The results indicated that a worthy subject for research had been discovered.

One welder produced samples which were poorly fused at the joint between the filler and the original material. Six of his specimens ruptured at this point. His one good sample gave a high reading. The values are given in Table III:

Table III.

Specimen No.	Ultimate Strength Lbs. Per Sq. In.	Elongation Per Cent In 2 Ins.	Reduction In Area Per Cent	Weld Efficiency Per Cent
1	42,200			72.4
2	44,700			76.5
3	44,500			76.3
4	47,900	26	27.9	82.0
5	40,500			69.4
6	41,800			71.6
7	43,800			75.1

The second operator's specimens all broke in the weld but away from the joint between the filler and the original material. The results are given in Table IV:

Table IV:

Specimen No.	Ultimate Strength Lbs. Per Sq. In.	Elongation Per Cent In 2 Ins.	Reduction In Area Per Cent	Weld Efficiency Per Cent
1	52,100	36.5	48.5	89.4
2	49,600	37.5	41.5	85.0
3	51,600	25.5	27.5	88.5
4	52,300	24.0	27.2	89.5

These tests were not taken as conclusive evidence regarding any theory that might have been in mind. It was simply a verification of the little that was known regarding weld-strength. The weld efficiency, as will be noted, approached what had been considered a good working possibility. And the ductility in the first series of tests, which approximated usual working conditions, was very low.

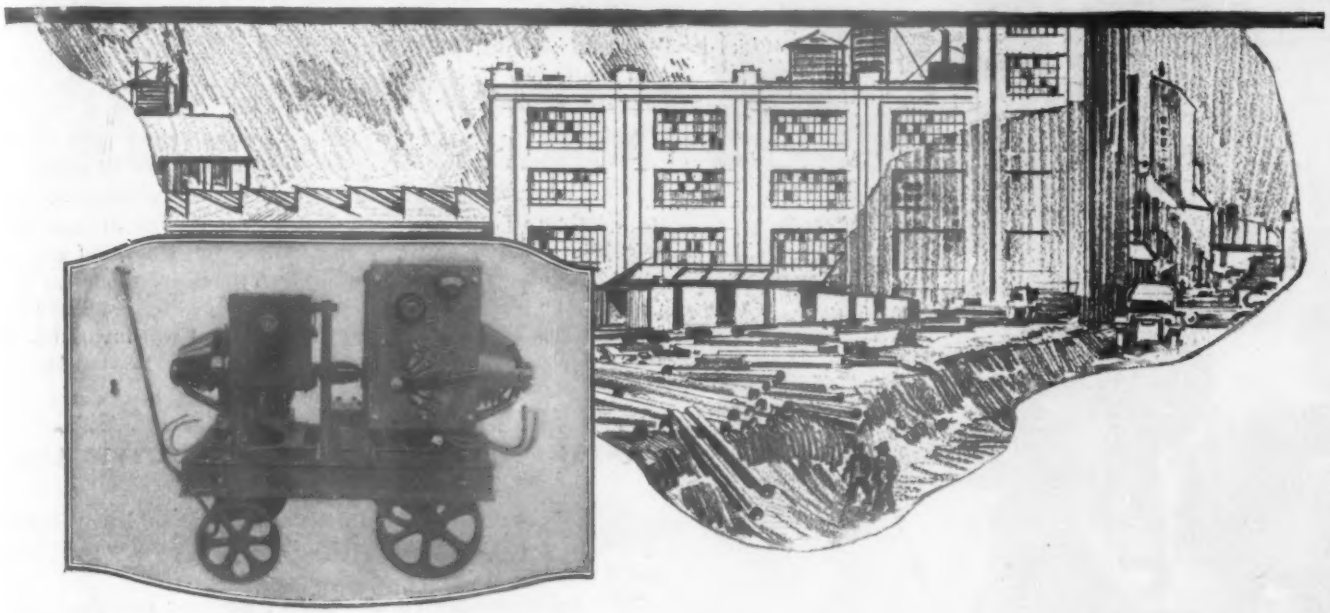
The second series of tests, however, where the filling rod itself was subjected to the strain, gave evidence of future possibilities. The readings in Table IV are such as any good welder should be able to produce under similar conditions.

This subject should attract the interest of every person connected with or engaged in the oxy-acetylene industry, as apart from its significance as a laboratory experiment, upon it hinges the future development and acceptance of an art which has at the present time many who are antagonistic and prejudiced.

CHICAGO SECTION DECEMBER MEETING

The regular December meeting of the American Welding Society, Chicago Section, will be held Wednesday evening, December 22nd, at 7:30 p. m., in the rooms of the Western Society of Engineers, Monadnock Building. The program for the evening will consist of a paper, "Why Some Welds Fail," by Mr. T. D. Sedwick, Engineer of Tests, Rock Island Lines. The paper will be illustrated by lantern slides showing tests made in the laboratories of the Rock Island Lines.

The activities of wartime industry proved beyond a doubt that the electric arc had been underestimated as a peace-time asset



Is There a Place in My Factory for Electric Arc Welding?

To answer this question, a manufacturer must ask himself three more:

"Can my product be improved or my production speeded up by this process?'
"Am I losing money through defective work which might be reclaimed by electric arc welding?"
"Does the repair work in my plant offer a profitable use of electric arc welding?"

If the obvious answer to any one of these is "yes," it is time for that manufacturer to investigate the possibilities of electric arc welding and learn what this remarkable science is doing in a wide variety of industries. He will discover that in shipbuilding, railroad shops, boiler shops, pipe mills, and hundreds of other plants where metal parts are permanently joined together, electric arc welding equipment is the answer to like questions—and many others.

To enable the manufacturer, who doubts the advantages of using electric arc welding in his own factory, to see for himself the possibilities of this process, the General Electric Company has made a thorough study of its various uses, and has built definite types of welding equipment to take care of almost every kind of work. This equipment is now available for prompt delivery.

Select the right equipment for the work—and a welder who knows his business

Bulletins describing G-E Welding Equipment and the G-E Welding School sent on request to our nearest office

433-374

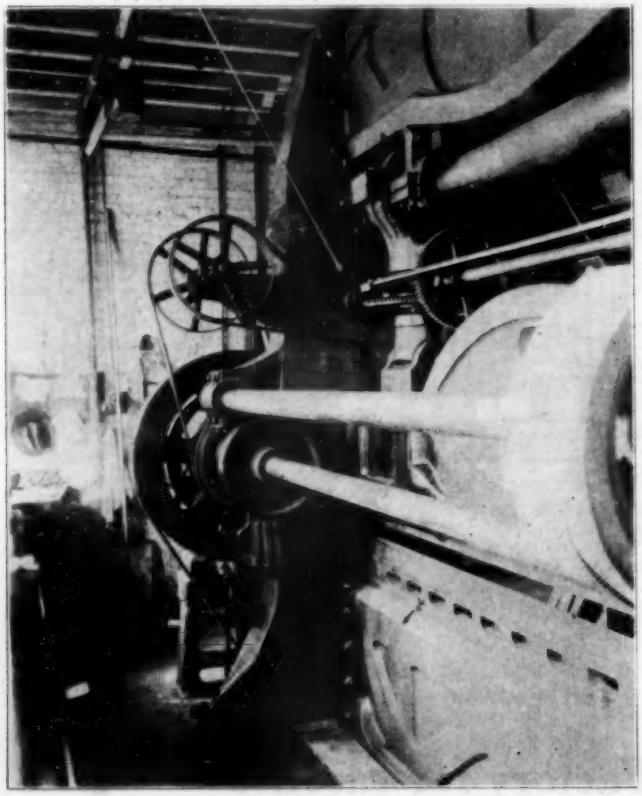
General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

WHEN ARE CAST IRON THERMIT WELDS FEASIBLE?

Almost every day in various industries the question arises as to the feasibility of welding cast iron sections of widely divergent sizes and shapes. The following explanation regarding the conditions governing cast iron welding recently



Thermit Repair of Cast Iron Side Frame of Power Press.

prepared by the Metal & Thermit Corporation, New York, may therefore be of interest to those contemplating repairs of this nature:

In Thermit welding, the superheated steel produced by the reaction, when tapped into the mold surrounding the weld naturally fuses back into the fractured parts 2 or 3 inches on either side and the whole mass solidifying at one

Thermit Weld Before Removing Riser.

time effects the repair. The excess metal of the weld may then be removed or not, as the necessity indicates.

In cast iron welding, steel is the welding medium and the weld material will, therefore, necessarily consist of a mixture of this steel and the cast iron of the parts being welded. The graphitic carbon in the cast iron, therefore, combines with the Thermit steel, thus making a high carbon steel which usually can be machined only by grinding. This material, however, is not so brittle as cast iron and is physically stronger.

In the second place, in considering Thermit repairs of cast iron, it should be borne in mind that the weld material is steel and, therefore, has double the shrinkage of the cast iron. This difference in shrinkage is of no importance where the section being welded is approximately square or equi-axed. Where, however, the length of the section at the fracture is four or five times its thickness, this difference in shrinkage is evidenced by one or more minute cracks perpendicular to the line of the weld and extending through the weld material only. These cracks are naturally caused by the difference in shrinkage, the cast iron parts tending to restrict the shrinkage of the Thermit steel along the length of the piece. Such hairline cracks will be found in the welding of sections such as, for instance, 12 in by 2 in., but would not be found in sections 12 in. by 12 in. The cracks are unimportant as they are parallel to the line of strain.

The experience of the Metal & Thermit Corporation over a long term of years with literally thousands of cast iron welds proves conclusively that where the length of a fracture is not more than four or five times its thickness and where the subsequent machining can be accomplished by grinding, a Thermit weld can be made and will invariably be successful. The accompanying illustrations show welds recently made, of the latter class.

PREVENTING HARD SPOTS IN ELECTRIC ARC WELDING

The following letter from a correspondent of The Welding Engineer will throw considerable light on the subjects of hard spots in electric welds.

"We have encountered difficulties from hard spots in a weld made by the electric arc process. However, we have never encountered a difficulty which we could not solve and eliminate. Using the metal electrode welding process with a mild steel electrode below .15 carbon and below .50 manganese, and welding on a casting having .35 to .40 carbon and .60 to .80 manganese, there is a certainty that we will get what is called a hard weld. As a matter of fact, the hardness is not in the weld but in the original material adjacent to the line of fusion. The reason we get this hard metal is that the original metal is of such an analysis that if it is heated up and chilled, it will be appreciably hardened. This is a rare case, but one which I encountered recently. There are two solutions to the problem. One of them is to anneal the casting after it has been welded, and the other one is to use a nickel electrode doing the welding very intermittently and not holding the arc at any time long enough to get great penetration. One very difficult problem was solved in this way. The reason the casting could not be annealed was that it was of such complicated shape that the annealing process would have warped it beyond the possibility of machining down to size.

"There are two cases in which we get a hard weld using the carbon electrode process on steel castings, the first case is that in which the operator does not manipulate the carbon electrode properly, and upon breaking his arc with a puddle of hot metal on the casting, starts the arc by dipping the carbon electrode into the molten metal. The net result is that sufficient carbon is left in the metal from the electrode to increase its carbon content to such a point that it will be hardened upon cooling. The way to get around this difficulty is to insist that the operator always start the arc on solid cooled metal and draw it over to the point at which he is welding.

"The case of reversed polarity on a carbon arc is very rare, because it is practically impossible to operate the carbon arc if the polarity is reversed. It is true, of course, that if the

Steel sections frequently break where their structure is weakest.

When heavy sections break

THERMIT WELDING

is the only reliable way to strengthen the "weakest link in the chain" in the welded section and avoid the breakage risk of an unknown "weak link" of an expensive new section.

Send for Pamphlet 1779

METAL & THERMIT CORPORATION

120 Broadway, New York

329-333 Folsom Street, San Francisco
7300 So. Chicago Avenue, Chicago, Ill.
15 Emily Street, Toronto, Canada
1427-1429 Western Ave., Pittsburgh, Pa.
Factories located at Chrome, N. J., Wyandotte, Mich., East Chicago, Ind., Jersey City, N. J.

operator used the polarity reversed on a carbon electrode, since the arc is maintained in the vapor of the positive electrode, which in this case is carbon, that the material will be carbonized and hardened.

"The remaining case in which we have difficulty from hard spots, using carbon electrode is that in which the casting is high in the combined contents of carbon and manganese. If the operator is using a rather heavy arc and melts a relatively small amount of metal at the point at which the defect occurs and the welding is done, and then breaks the arc, the result is that the small amount of metal which was heated is cooled suddenly by the mass of metal back of it. This, of course, results in hardening. The proper manipulation to solve this difficulty is to play the arc around the point at which the weld is to be made until a sufficient quantity of heat is put into the casting at that point to avoid the sudden cooling. This difficulty only occurs, of course, where the casting is not subsequently annealed.

"In regard to the comment in the letter referred to on the boiler job, it is of course impossible that with metal electrode process we could in any way change the carbon content of the metal adjacent to the weld. The factors which enter into an analysis of the case are, in my opinion, the skill of the operator for such a job, the condition of the crown sheet before the welding was started, the manner in which the weld was accomplished, the characteristic of the arc on the machine with which the work was done.

"Relative to the matter of the gear teeth, will advise that we have equipment which has been in operation for three years and eight months at one of the largest gear manufacturers in the country. Success in this application depends entirely upon the supervision given the work. On a new gear it would be absurd in my mind to attempt to put in a complete new tooth, because whether the metal is added by the gas or electric process, it will not be as good as the original. This does not hold, of course, in the case of a repair job, where the matter of keeping the gear in service is of greatest importance.

"In conclusion will state that it has been my experience that the gas weld and the arc weld are equal in all respects for commercial welding purposes, although in considering laboratory work I have seen better gas welds than I have seen electric arc welds."

OXWELD ISSUES REPRINTS FOR THE COAL INDUSTRY

The Oxweld Acetylene Company's Chicago office recently issued the first of a series of reprints that it will circulate from time to time for the benefit of coal mine operators and others connected with the industry. These reprints, taken from the various trade publications, will pertain especially to oxy-acetylene welding and cutting for emergency repair work about the colliery. The initial issue is an illustrated article by Charles C. Phelps, entitled, "Oxy-Acetylene Promptly Clears Shaft and Repairs Engine Bed After an Overwind."

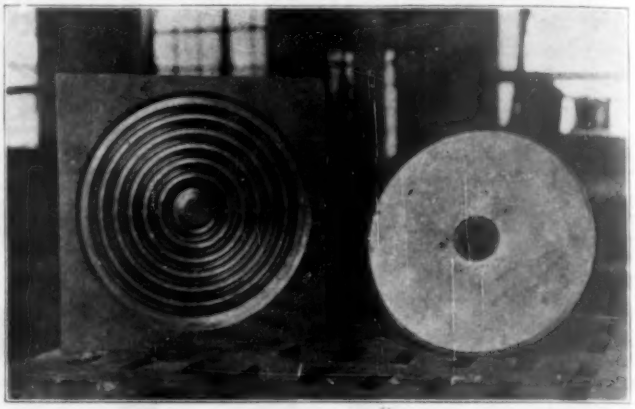
The Oxweld Company's distribution of this matter is very timely, especially owing to the need for keeping production going on uninterruptedly, and there should be much of interest to the industry in the article reprinted. Any operator or other interested person who has not received a copy of the reprint will be sent one copy free by return mail on request addressed to the Oxweld Acetylene Company, 36th St. and Jasper Place, Chicago, Ill.

A. H. York, formerly with Davis-Bournonville Co., Philadelphia office, is now associated with the Cumberland Welding & Repair Co., Cumberland, Md.

UNUSUAL WELDING APPLICATION

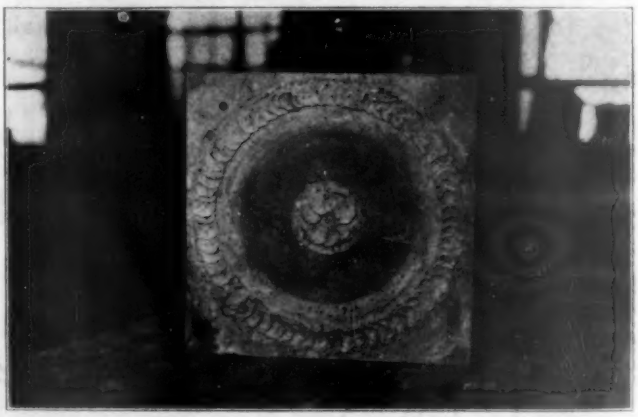
The first and last stages of an interesting and unusual application of welding are shown in these illustrations.

This work was performed by the welding shop department of the Oxweld Acetylene Company at its Newark plant, for the Watson-Stillman Company, manufacturers of hydraulic machinery, Aldena, N. J. The latter company has a contract to furnish steam-heated brass platens for the curing of phonograph records.



Parts Prepared for Welding.

After trying a number of methods of making the necessary steam passages in castings by the use of cores, it became evident that satisfactory castings could not be produced by this method. Accordingly, a new line of procedure was undertaken, to wit: In a solid rolled-brass plate (1½" thick by 14" square) concentric grooves were turned to a depth sufficient to give the necessary steam capacity. The whole working face of the plate (12" diameter) was also cut away to a depth of ⅜" except for a central boss, to accommodate a cover plate which was to be welded to the central boss and to the outer circumference of the undercut. This central boss and the outer circumference of the undercut were chamfered away in the manner usual for preparing an edge



The Welded Platen

to edge weld. The circular cover was then prepared with the edges bevelled in the same manner, leaving the usual trough for welding. A specially prepared clamping jig was then affixed to prevent warping, due to contraction strains, the entire job was preheated, the welding done in the usual way and the plates allowed to slowly cool in the fire. As a result of the annealing all contraction strains were satisfactorily eliminated.

The final operation was performed by facing off the plate in a lathe and the work was so well done that it was barely possible to discover the joints. The plates have given complete satisfaction in service.

A PORTABLE ARC WELDER

The Electric Arc Cutting & Welding Co. has developed a welding machine weighing complete 100 pounds, which, with reasonable care, will accomplish any work in or around a garage or garage machine shop, etc. The machine will use electrodes from 1/8-inch to 5/32-inch and will operate continuously with the medium and small sizes, and intermittently on the large sizes. Standard lines of machines are built to operate absolutely continuously, but careful design and development produced this machine which will fill any and all the requirements for automobile repair work, plumbing shops, sheet metal work, electrical shops, etc.

It is also very handy in a job welding shop where electrical experience is available and discretion is used as to its capacity. Every available care is taken to reduce the weight and maintain its capacity. It probably has not as many limitations as one would be led to believe from the foregoing. The only point is, it cannot be guaranteed on a heavy boiler or engine job for continuous duty, although it will do such work if used with discretion, and with the proper discretion, the machine will last a lifetime.

This machine will operate on either 110 or 220 volts, and any frequency specified in the order, and the machine can be made for other voltages, but the standard worked up design is for both of the voltages mentioned, that is, there are two coils in series on 220 V and in multiple on 110 f. The power supply must be of at least 5 KVA in order to use this machine, and be within the underwriters' regulations. While it will operate from a lamp socket with the smaller electrode, it is not allowable or good engineering to do so. If 5 KVA is available, however, it will operate connected to the panel board from which the lights are distributed. It will operate for less than 1 KWH per hour or in general less than 3c an hour.

Portability of the Small Arc Welder.

The connections are very simple. Two wires are hooked from the machine to power supply and two other wires which are furnished with the machine, are attached to a plugging in board unit mounted on the machine for regulation. In order to make the machine standard, there is included in each machine provision for operating on the following voltages—90 to 130 volts and 180 to 260 volts.

The uses to which this machine may be put cover every field of arc welding that could be encountered, except perhaps doing very heavy work rapidly, as above stated; however, it will do the heavy work but at a reduced rate, i. e., not economical for production but at a rate perfectly economical for emergency repairs.

Around a garage or automobile repair or machine shop, the uses to which this machine can be put are as follows: Repairing of scored cylinders by spotting and peening with a nickel electrode, and straight repair welding of cracked and broken blocks, and mudguards, mudguard brackets, cracked water jackets on cylinders, broken frames and other chassis parts such as lamp brackets, bumper brackets, tire holders, step brackets and any part around the chassis which has become loosened due to wrenching or wear, may be tightened up forever with this machine. Squeaks and rattles otherwise impossible to get rid of, can be cured forever and very quickly with this machine. In the automobile machine shop, parts that would have to be bushed or replaced can be built up to beyond their original dimensions and machined down to their correct size. Other broken parts such as crank shafts, connecting rods, universals, worn teeth either gears or connection dogs, or anything worn in or about the car, can be built up and machined back to its original dimensions.

Lead burning, either on or off, can be done beautifully with this machine. That is, batteries can be taken apart, repaired and put together again without flame or fire, the attachment for this purpose being simply a white hot glowing point made so from the characteristics of the machine. Spot, butt or tack welding of small thin pieces can be rapidly accomplished with this machine. The machine, because of its portability, can be taken anywhere to accomplish the job such as the repair of a heating or power boiler or tightening of radiator sections in places where it would not be advisable to dismantle and where the machine can be easily moved.

Places other than garages where this machine would be useful are as follows: Electrical shops, plumbing shops, building contractor, maintenance of tanks and boilers, sheet metal and tinsmith shops, blacksmith shops, factories of any nature employing machinery where emergency repairs would keep production at its height.

WELDING SCHOOLS PLEASE WRITE

The publishers of The Welding Encyclopedia desire to incorporate in the 1921 edition as much information as possible concerning the welding schools now in operation in the United States. The questionnaire reproduced below has been mailed to all the schools of which we have record. Directors of these schools are urged to send this information at once so that no school will be left off this list when it is published.

Questionnaire

In the 1921 edition of The Welding Encyclopedia, which is now being made ready for the press, we wish to publish complete information regarding all the welding schools in the United States. Will you co-operate with us to the extent of filling out the questionnaire below and mailing it to us?

1. Name of School.....
2. Address .....
3. Night or Day Courses or Both?.....
4. Do You Teach Electric Arc Welding?.....
5. Do You Teach Oxy-Acetylene Welding?.....
6. Is the Welding Course Related to Other Courses?.....
7. How Many Weeks in the Course.....How Many Lessons?.....
8. What is the Cost of the Course to the Pupil?.....
9. How Much Time is Devoted to Practical Work?.....
10. How Much Time is Devoted to Lectures?.....
11. What Metals do the Pupils Learn to Weld?.....

.....

12. Is Brazing included in the Course?.....

If there is any additional information concerning your school that would be of interest to our readers, we would be glad to have it. The above information is desired concerning all welding schools. We thank you for your co-operation.

METAL & THERMIT CORPORATION OPENS BOSTON OFFICE

The Metal & Thermit Corporation, New York, in order to take care of its rapidly increasing business in the New England territory, has opened a branch office at 141 Milk Street, Boston. Inquiries addressed there will have the personal attention of the New England District Manager, Robert L. Browne. Orders, however, should continue to be addressed to the General Office of this Company at 120 Broadway, New York.

The Welding Engineer

Reg. U. S. Pat. Office.
Published on the 17th of Each Month by
THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor
H. S. Card.....Associate Editor

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries ..... 4.00 a year
Single copy, domestic .....25 cents
Single copy, foreign .....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 15th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails.

The Welding Engineer is the official organ of the American Welding Society.

Eastern Office:
171 Madison Ave., New York. Telephone, Murray Hill 4894.
Max I. Barth, Eastern Representative.

The Welding Engineer in Australia and New Zealand.
Mr. R. Hill, Matlock House, Devonport, Auckland, New Zealand, is our accredited representative in Australia and New Zealand for obtaining new subscriptions.

VOLUME 5. DECEMBER, 1920 NUMBER 12

CONTENTS FOR DECEMBER

The Metal Arc Welded Battle Towing Target Built at the Norfolk Navy Yard..... 23
Efficiency of Oxy-Acetylene Welding..... 29
When Are Cast Iron Thermit Welds Feasible?..... 34
Preventing Hard Spots in Electric Arc Welding..... 34
Unusual Welding Application..... 36
A Portable Arc Welder..... 37
Editorial 38
Why Pick on Acetylene?
A Welded Flag Pole..... 39
Welding School at Camp Pike..... 42
Backward Welding 42
Welding a Cylinder Head..... 44
Tack Welding 46
Oxy-Acetylene Aids Huge Engineering Project..... 50
Current Welding Literature..... 54

Why Pick on Acetylene?

THERE is no commercial product that is more frequently misrepresented in the news columns of daily papers than acetylene. The average reporter seems to have a special weakness for the word, as if it were a general term applicable to, if not actually essential to, a proper denomination of all mysterious, or not definitely identified, explosions.

Every little while one reads of acetylene explosions or the explosion of acetylene torches, and when the reported cases are authoritatively investigated, as they always are, it is discovered that in nearly every instance the explosion was not an acetylene or an acetylene torch explosion at all. Sometimes, by way of injecting a little variety, it might appear, the cause of an accident of the kind is given as an oxygen explosion. These reports do not occur so frequently as the ones attributing explosions to acetylene, but like them they are found upon searching inquiry to be, in a majority of instances, entirely without foundation in fact.

The big evident fact in each case is that there has been an explosion from some cause not definitely known. Explosions as a rule occur in industrial plants. Industrial plants almost without exception, employ oxy-acetylene welding and cutting in some part of their plants. The cub reporter, hungry for sensation, and without technical knowledge, will, if not restrained, mis-educate the public mind to the idea that acetylene is a very tricky gas that keeps one eye open all the time awaiting its chance to blow up and kill somebody. That notion grew out of the publicity given to explosions of acetylene in the early days of the industry before the development of present-day safeguards for the generation and compression of acetylene. Because the industry was new these explosions attracted much wider interest than was the case in even more disastrous explosions of boilers, for example. Acetylene piqued the imagination—and it still does. It makes good "copy."

Getting back to explosions of unsolved origin, what is more natural than for the sleuths of the press—for every reporter is a detective at heart—to yield to the ever-assertive weakness of their guild for sensation and word effects and gratuitously hang the responsibility on acetylene—or oxygen? Our newspaper scribes, given to the artful scrambling of fact and imagination—and scant time for maturing either—should not be expected to be immune to temptations of this sort. But why can't some other highfalutin gas be made the goat? Why pick on acetylene? There are plenty of other gases with polysyllable names and with explosive kicks to meet the most exacting requirements—sly gases that occasionally land punches like a Dempsey or Carpentier, or like a charge of TNT, wrecking buildings and vivisecting men regardless. Acetylene and oxygen have been blamed for a heap of sudden freaks of these culprits, but it would make too long a story to cite particular cases.

There may be no adequate way of educating the newspapers. It has been tried, and the principal offenders appear to be too busy to learn, or perhaps they just don't want to learn. Anyway, they go on repeating misrepresentations of acetylene and oxygen in connection with explosions, and very likely they will continue to do so. After all, the practical thing is to reduce the number of explosions, from whatever cause, if that be possible—and it ought to be. Of course, the first essential is to understand the causes of explosions. It is a large subject on which too much can not possibly be written, if true. The subject is too big for anything but a hint in this short article, but if the hint here given is acted upon there is little question that some of the miscalled acetylene explosions will be prevented.

Master of the Scrap Yard

THE oxy-acetylene cutting blow pipe can cut up more metal in less time than any other tool.

With Prest-O-Lite, the Universal Gas with the Universal Service, both cutting and welding can be accomplished anywhere economically.

Prest-O-Lite is used by so many industries, and in so many inaccessible places, that we should like to tell you *all* about it.

You will be surprised in the many ways the oxy-acetylene process and Prest-O-Lite can be used in every manufacturing plant.

Write us for information about the Prest-O-Lite Nation-Wide Service Plan and the facilities of our forty plants and warehouses.

THE PREST-O-LITE COMPANY, Inc.
GENERAL OFFICES, CARBIDE AND CARBON BUILDING
30 EAST 42ND STREET, NEW YORK

KOHL BUILDING, SAN FRANCISCO

In Canada
PREST-O-LITE CO. *of* CANADA, LIMITED, TORONTO

PW-524

One does not read much of the danger of air and water as explosive agents. Of course when a boiler explodes the water has been converted into steam. But just simple, every day *acqua pura,* the kind that comes into the well or the bathroom faucet is explosive under certain conditions. And so is air explosive under the same conditions. Unfortunately those conditions obtain under circumstances in which they are not always apparent. They, the conditions, are: confinement and application of heat in sufficient degree for the expansion to burst the confining walls. Some of the circumstances in which these conditions are not apparent are evidenced from time to time in "acetylene explosions" where no acetylene is used and in "acetylene explosions" in which, though used for heating, acetylene did not explode. An example of an explosion of this kind in which acetylene was not used at all, was the explosion recently in a New York welding shop where, because oxy-acetylene apparatus was a part of the plant equipment, the news-sleuths deduced another "acetylene explosion." It was not reported in one, but in all of the New York City dailies as an explosion of acetylene. The facts were these: An automobile tubular drive shaft was placed in the fire of an ordinary blacksmith's forge for heating preparatory to straightening the tube. Unknown to the workmen, the tube contained confined air. Had there been so much as a pinhole the expanding air might have escaped without violence. It would have been a very simple matter to tap the tube with a drill. This precaution was not taken merely because the air inclusion was not obvious. The result was an explosion that sent several workmen to the hospital to be treated for burns sustained from the flying embers from the forge. No damage was done to the shop, but the force of the bursting tube and released air was sufficient to endanger the lives of the workmen.

Quite similarly the other day a workman engaged in welding a hollow metal ball some three inches in diameter, did not know that the ball was filled with water. Why it was so filled is still a mystery. But the water expanded under the heat of the welder's flame, bursting the shell of the ball and exploding like a bomb. Fortunately the workman was not killed, and was thus permitted to learn by experience what all the rules of caution ever put into print could not teach him so thoroughly. It is safe to wager he will never again "take a chance" welding any hollow metal without first tapping it to vent whatever it contains. This also was served up to newspaper readers as an oxy-acetylene explosion. Of course it was nothing of the kind; but by the time the facts were ascertained the story had ceased to be news, so it goes unretracted as just another of those acetylene explosions!

A little knowledge, a little horse sense and the caution these beget ought to go a long way toward eliminating the types of accidental explosions just noted.

A WELDED FLAG POLE

Editor:

Your article in the November issue regarding the flag pole hazard, gave me a hunch to dig down among my welding photographs and mail you two pictures of a 110-foot flag pole which was built in my welding and machine shop in August, 1918.

This pole starts with 10⅝ inches oil well casing and tapers to 3 inches, capped with a revolving halyard and gold ball. The horizontal photograph shows the way in which the upper end of each pipe was prepared, viz:

First, six equally spaced wedges were cut in end about 6 inches long, then three equally spaced 1½-inch holes were made 2 feet 6 inches from end of pipe.

Then the end of the smaller pipe was slipped inside about 2 feet 8 inches and centered up, welded and built up through holes in large pipe until the surfaces were even.

The Pole in Service.

The end sections were heated and driven down onto small pipe and the end of the large pipe was welded to the smaller one. The wedge slots were also welded, same being about the proper width for a good weld.

Fewer slots and smaller holes were used in smaller pipe.

Making the Joints.

The flag pole committee asked for a safe and strong pole and they have it.

Sincerely,

W. H. Crakes.

Mr. J. Paterson, 30 Queen Street, Sydney, Australia, desires to receive literature on welding and welding equipment.

THE "ALTERNARC"
100 Pound Welding Machine

This machine is especially adapted to the class of welding done in Machine, Plumbing and Sheet Metal Shops and is an efficient and speedy worker.

While we do not recommend this type for the heavier welding duties done by the larger "Alternarc" types, it will do this work in emergencies.

We manufacture other types to meet any condition.

"NEWARC" WELDING ACCESSORIES
consisting of highest quality Electrodes, Holders, Helmets, Aprons, Gloves, etc., all of the highest quality.

Our engineering department will give you facts and figures on "Alternarc" Welding. Send for Literature—Series D.

THE ELECTRIC ARC CUTTING & WELDING CO.

152 Jelliff Ave., Newark, N. J.

Pittsburgh
Cincinnati
Chicago

BRANCHES
Cleveland
St. Louis
Detroit

Philadelphia
Montreal
Indianapolis

"ALTERNARC" CUTTING and WELDING

EA-7

Style "D"

Bare Facts

These Hand Shields are made of a strong light fibre. Our improved Lens holder and "ESSENTIALITE" lenses are part of the regular equipment. Style "D", weight only 8 oz. Style "L", weight only 9 oz.

Style "L"

Proper protection for the welders' eyes has been given our undivided attention. Suffice to say we offer only the proven correct types.

Chicago Eye Shield Co.
2300 Warren Avenue
CHICAGO, ILL.

One of the Best and Most Economical Generators Manufactured

Manufacturers of
Welding and Cutting Apparatus
Lead Burning and Carbon Burning Outfits
Welding, Cutting, Sheet Metal
Lead Burning and Battery Torches
Acetylene Torches
Regulators and Gauges

Cast Iron Rods, 24 in. long
Tobin Bronze Rods
Manganese Bronze Rods
Aluminum Rods
Aluminum Solder
Brazing Wire
Brass Spelter
Fluxes (all kinds)
Carbon Rods and Paste
Instructions Book on Welding

Steel — Norway, Swede, Superior, Vanadium, Nickel

Distributors of Our Entire Line
I. J. COOPER RUBBER CO.

Cincinnati, Ohio	Nashville, Tenn.
Dayton, Ohio	Knoxville, Tenn.
Toledo, Ohio	Memphis, Tenn.
Columbus, Ohio	Birmingham, Ala.
Cleveland, Ohio	Chicago, Ill.

Indianapolis, Ind.

Preheaters
Drills and Grinders
Asbestos Paper
Asbestos Gloves
Hose, Plain and Armored
Welding Plates and "V" Blocks

WRITE FOR MONTHLY PRICE SHEET AND CATALOG
Agents wanted in unoccupied territory.

Superior Oxy-Acetylene Machine Co., Hamilton, Ohio, U.S.A.

Our New England States Representative,
R. I. WELDING CO., Providence, R. I.

Ohio Rubber Co., Cincinnati, Ohio

THE OXY-ACETYLENE WELDING TRAINING SCHOOL, CAMP PIKE, ARKANSAS.

The Government, fully aware of the value of technical education for the Army, has been endeavoring for many years to develop a system, which would prove of special benefit in case of war and at the same time give the men in the service an opportunity to learn a trade, thus better fitting them for civilian life at the end of their enlistment.

This need was particularly emphasized during the recent war, when, in a very short time, they were compelled to train more than one million men along technical lines. This then was practically one of the first steps towards the opening or establishing of vocational training schools for the Army.

Started, as stated previously during the war, they are now continuing the work by opening vocational training schools at the various camps throughout the states. This year at Camp Pike, all the schools, splendidly equipped, are well under way, especially that of the oxy-acetylene welding. The term covers a period of six months and the course will be an extensive one, the training being not only a practical but a theoretical one. The practical work will cover everything that can be done in the average welding shop, while the student will be given instruction and reference books for home study of the art. A short examination being given each week to determine the benefit he is deriving from his text books.

The students began at the first rung of the ladder of the art, and installed the equipment, which consists of two 200-lb. generators to supply the acetylene to the 24 welding stations. They also built their own welding tables, which are 32½x27 inches. The frame and legs are made of 1½ inch angle iron with fire brick tops and are so constructed the two of them may be placed together for the larger work. The work will be considerably varied as it is the intention that the students will do all the new work and also look after the repairs that from time to time are needed in the upkeep of the camp. Already cylinder blocks, crank cases, transmission cases, gears, pulleys and sections of furnaces are some of the jobs welded daily at the camp.

In order to give the class every advantage possible in the art of welding, the organization at Camp Pike have not confined them to any one style of equipment but have arranged to use that of several manufacturers. In this way they will become acquainted with the different makes and thus gain a broader knowledge than the average welder.

The school at present comprises a class of twenty-nine. At the end of the term a diploma will be given to each one that shows himself not only capable of manipulating the torch but also master of the art of welding. While it is not anticipated that they will all turn out expert welders, yet we can look forward to a goodly number, as most of them, realizing the opportunity they are being given, are showing an active interest in the work and displaying splendid adaptability and will be, it is hoped, a credit to the welding trade. Good welders, nowadays are in demand as so many so-styled welders have caused an adverse opinion of welding throughout the country.

Among the many interesting exhibits displayed by Camp Pike at Arkansas Horse Show held recently at Kavanaugh Field, Little Rock, that of the Oxy-Acetylene Welding School drew very favorable comment. Being under instruction for such a short time the exhibit was necessarily small, but the work of the students was of a first-class order and gave promise of a bright future.

"BACKWARD WELDING"

THIS comparativly new method of making welds which was recommended for sheet metal welding about a year ago is beginning to find increased favor in welding shops. It hasn't been so widely adopted as it should be, however, for we must make allowances for the difficulty in making welders change their method of working and also for the lack of welding knowledge on the part of many shop foremen who do not keep well posted on the progress that is being made in welding methods.

On the other hand, welders experience a noticeable difficulty in getting rid of the habit of alternate movements of the torch which many of them persist in applying to backward welding. This results, naturally, in a greater width of the puddle, for the fused metal tending to flow ahead of the filler rod as soon as the torch is drawn away, the weld is made then by parts instead of being continuous and "automatic."

It may be said that one of the principal characteristics of this method of welding is that it encloses theoretically the conditions of execution and the motions of the welder within such narrow rules that the operator would find himself in a way filling the role of a welding machine, if it were not for the fact that his intelligence and his judgment must be constantly in evidence.

Let us recall again that contrary to what takes place in the execution of welds by the right to left method, the torch in backward welding must be fixed. This fixity is evidently not absolute as in the case of a welding machine and the reflexes of the right arm as well as a certain balancing of the body due to the regular movements of the left arm, which controls the filler rod, give to the torch a slight oscillation transversal to the line of the weld, which aids in setting up the fusion of the faces of the bevel.

This movement, if used intentionally in cases of thick enough pieces, does not really give to the torch the appearance of displacement and we can say that it is practically fixed. There is also a great advantage in the process in that here the heat is used to its maximum efficiency.

Let us recall that the welding flame is plunged into the V of the bevel to about half the depth of the V; there we have an excellent condition of using the flame, permitting a more rapid fusion and a less extended fusion and by consequence a rapidity of execution and a greater economy over the other processes.

We do not hesitate to state that in many shops they use too large a quantity of gas for the execution of welds by the ordinary methods. We have had a chance to make note of consumptions of gas much higher than would have been necessary by the application of good working methods: a welder, for example, who works without supervision commences to weld 3/8" sheets by melting the faces of the bevel on the whole line of the weld, then commencing at the beginning, he adds the necessary quantity of metal to fill up the space thus formed. This is called "welding by two strokes."

Others who have for example to join tubes of sheet steel of about 1/16" thickness with the edges bevelled beforehand, leave at the bottom of the bevel a space of about 3/16" causing a useless increase in the width of the weld and consequently an increase in the time of execution and consumption of gas.

It is not rare to meet in this industry welds on sheet metal 1/16" showing 7/8" to one inch in width and on sheet metal 3/8" thick showing 1⅛" to 1¼" in width and even more; the consumption of gas in such cases is from 50 to 100 per cent higher than it should be normally. It is a principle admitted in this field that a weld will be better if it is made more rapidly. We understand, in fact, that

the metal of any weld which remains long under the torch or the metal of any puddle which is played upon for a long while by the flame will be more easily over-heated, oxidized or "denatured" than in the case of a rapid execution of the work. Every slow advance of a weld executed with a torch of the right size is characterized by too large a puddle; the same thing is true for welds executed on sheet metal that has not been beveled, for those in which a space is left between the beveled edges of the sheets, and finally when a defective preparation of the sheets leaves considerable spaces along the line of the weld.

The advantage of the method of backward welding lies in giving a minimum width to the weld; the quantity of metal affected by the fusion is smaller than in the other methods of welding. We understand, in fact, that the heat being utilized better in the bevel will be used to melt more metal at the bottom of the angle, affected only a small part of the metal on the edges. That is the whole secret of the narrow width of the puddle obtained by the new method.

The difference in the widths of welds obtained by the two methods is not very great in thicknesses up to ⅛" but it increases rapidly as soon as we reach thicknesses of from ¼" to ⅝" and more. It is permitted by this method to decrease the angle of the bevel, which can be as little as 30 degrees on each side.

According to M. Em. Roulleau, the promotor of the method of backward welding, we can, at the beginning and for practice, use the bevel up to 90 degrees and gradually decrease this angle to 60 degrees, which is the limit fixed by experience in finding the basis for stopping the decrease of the angle of the bevel when during the execution of the weld we notice a drawing of the fused metal ahead of the torch. The angle of 60 degrees having been thus determined, we can know approximately in advance the normal width of the weld which we have to make.

From the numerous trials that we have made, we conclude that we can determine in advance that maximum width which a backward weld ought to produce whatever be the thickness of the sheets to be joined, at least above ⅛" thickness. This width of the weld will be a little greater than twice the thickness of the metal. To be exact, and if it is not ridiculous to put everything in a formula, we could apply the following formula

$$2E+\frac{E}{5}$$

in which E represents the thickness of the sheet which we are welding. The figure thus obtained, indicating the width of a backward weld on sheets properly beveled, is a maximum. We mentioned above that among the causes of mistakes in welding was the habit which many welders persist in keeping, of moving the torch; there naturally follows a deep penetration of the upper edges of the sheets by the flame which is then held too high.

Backward welding gets its qualities of rapidity of execution and economy of gas from the application of the principles which we have just recalled. However, the principal causes which actually opposes its rapid development is the necessity of bevelling to 60 degrees the sheets to be joined. The necessity of beveling is not disputed any time that we wish to obtain more rapid fusion over the whole thickness to be welded, to more easily avoid adhesion and finally to be able to add in the puddle the right quantity of a metal that is purer, of different quality, or possessing elements that will have a beneficial effect on the value of the weld.

But we must, in industrial practice, take count of certain commercial points of view or of the lack of proper equipment which account for the fact that very often bevelling of the edges to be welded is not practiced. It evidently follows then, in the execution of welds without bevelling, and by ordinary methods, that more gas is used and the quality of the metal is lowered, by reason of the slower progress and the intense heating of the puddle which takes place when the weldler insists upon criss-crossing.

Considering the splendid results obtained by the method of backward welding, we have thought that we could perhaps find new points in favor of it or discover new qualities in it and we have tried the application of the process to welding as it is often practiced in industry, that is to say, without bevelling.

We tried to determine whether it would be possible to dispense with bevelling and backward welding on sheets that were simply separated. It should be understood that we did not count on being able to obtain the same rapid execution; we simply tried to determine if it would be possible to adapt the method of backward welding in this case as a half way measure; that is, all other conditions being equal, to see if backward welding would be more economical than forward welding without bevelling, at the same time being less economical than backward welding on sheets normally beveled.

Up to this time, we have only accomplished a few rapid trials but they confirm our theories. Backward welding on sheets not beveled is done by separating the edges to be welded a distance that we can fix approximately at half the thickness of the sheet; the movements of the torch and of the adding material are nearly the same as in welding on beveled edges. The width of the puddle as well as the volume of the metal melted are almost the same in both cases. However, as we thought, the rapidity of execution is lower and is between the rapidity of execution obtained in backward welding on beveled material and that obtained by forward welding on material not beveled. This decrease in spee, although the volume of the metal influenced by the fusion be the same, shows simply that in the execution of a backward weld on a 60 degree bevel the fused metal is supplied by the filler rod which evidently melts more rapidly under the flame than the edges of sheets not beveled.

We expect to take up this question again and to make more experiments with this method along with the other methods employed up to this time.

While waiting for more complete trials and for tests bearing on the strength of the welds thus obtained, it seems as if we can at least see the possibility of obtaining in welding shops a decrease in the cost of making welds, which is actually wished by all construction engineers using autogenous welding, by the use of backward welding even on sheets not beveled.—*Marcel Piette in Revue de la Soudure Autogene.*)

Editor's Note:—"Backward Welding" has been defined (in the February, 1920, issue of The Welding Engineer) as the method of executing a weld in which the welding rod follows the torch as opposed to preceding it. Or again, it may be defined as a method in which the flame is inclined towards the welded portion. A fuller and perhaps better definition would be: The flame is inclined backwards and only undergoes a slight transversal motion in addition to its regular advancement, the welding rod follows the flame and is given a movement, the end of the rod always being molten.

CUTTING 44-INCH RISER

Heavy cutting with the oxy-acetylene flame has become so common that today nothing short of a super cut attracts particular notice. A real super cut was made recently in the plant of the National Car Coupler Company at Attica, Ind., when a cutter tackled a 44-inch (square) steel riser. The cut was rendered more difficult because of the upright position of the riser, which necessitated a horizontal cut. If the riser had been horizontal and the cut vertical the operation would have been much simplified. To off-set this difficulty the

A Horizontal 44-inch Cut.

operator resorted to first cutting the corners of the riser so as to reduce the uncut cross section to a smaller square. This operation was repeated until the remaining stem could be easily cut through.

In this manner it would appear that there is no limit to the thickness of steel that can be cut with the oxy-acetylene torch, as the operation of slicing off angles can be carried to any desired extent so long as access to the metal with the cutting flame is provided.

GAS MANUFACTURERS ANNOUNCE MEETING

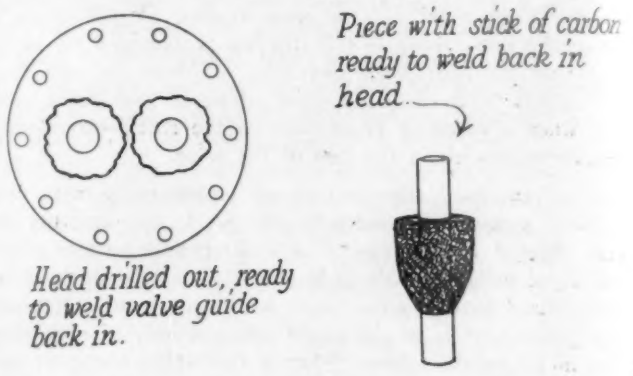
The Compressed Gas Manufacturers' Association will hold its eighth annual meeting at the Hotel Astor, New York, on January 17, 1921, at 2:00 P. M. The eighth annual dinner will be held at the Astor also, at 7:00 P. M. of that day.

This association represents every compressed gas industry in this country and Canada and practically every manufacturer in each industry is a member of the association. In addition there is an associate membership consisting of manufacturers of apparatus and machinery for the manufacture and use of compressed gases.

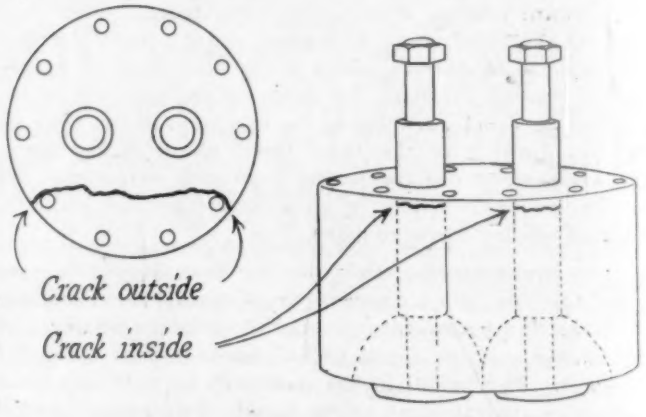
At the seventh annual dinner of the association 250 members were present and it is hoped that the attendance at the next dinner will reach 300. Tickets are being sold at $7.50 each and include everything that could possibly be associated with a very happy gathering of this nature.

WELDING A CYLINDER HEAD

Editor:—I am sending sketches of a cylinder head that I recently welded. It is a comparatively simple job, yet several small shops in this locality turned it down. You will notice



that the valve guides were broken inside of the head. Most welders could weld the outside crack all right but they were stuck on the valve guides. When I undertook the job, I drilled out the top of the head around the valve guides and took them off where they were cracked. I then ground the pieces off to a point and stuck them back on with a stick of carbon in the hole to keep them straight and prevent any metal getting in the



valve guide. Next I welded these two on without preheating. After these welds were completed, I preheated the whole head and welded the valve guides to the outside jacket. The valves were ground after the job cooled. Altogether it was a successful little job, and some other welders may find a useful suggestion in this description of it.

F. G. Hartwell.

APPOINTS EASTERN DISTRIBUTOR

The Oxweld Acetylene Company announces the appointment of the Standard Supply & Equipment Co., of New York and Philadelphia, as eastern sales agent for Eveready welding and cutting apparatus and supplies.

The Standard Supply & Equipment Company deals in shelf and heavy hardware, machinery, mill and mine supplies, automobile accessories, etc., and has, besides its New York and Philadelphia establishments, branch houses in New Haven, Hartford, Springfield, Worcester, Pittsburgh, Trenton and Altoona.

The company has appointed as manager of its welding and cutting equipment department, Mr. George E. Temple, for six years connected with the Prest-O-Lite Company, which formerly manufactured and marketed the apparatus now everywhere known as "Eveready."

VICTOR
TRADE MARK

Welding and Cutting Apparatus

VICTOR welding and cutting apparatus is now sold at the following cities:

Chicago, Ill.
Detroit, Mich.
Portland, Ore.
El Paso, Texas
San Francisco, Calif.

SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY

H. M. BYLLESBY & CO.
MANAGERS AND ENGINEERS

ADDRESS ALL CORRESPONDENCE TO THE COMPANY

SAN DIEGO, CAL.,

May 5th, 1919

File: 444.3

Mr. F. W. Clifford,
Victor Oxy-Acetylene Equip. Co.,
884-886 Folsom Street,
San Francisco, Calif.

Dear Sir:

Replying to your letter of April 30th, 1919, so far the water cooled torch has done all that you claim for it and our welder, Mr. Black, is very much pleased with the work. He says it is the first time that the "Bunk" handed out by the representative of a welding torch ever came true. We have only had occasion to use it on a number of small jobs, but found it very satisfactory. One job we feel certain we would not have accomplished with old torch. We had a truck cylinder block that had two scores about ¼" deep and 8" long. The walls of the cylinder were only about 5/16" thick. This work was done with the No. 8 tip and after job was completed, we found the cylinder a little out of true but found it O. K. after cylinder was rebored, and we could hardly detect the new metal from the old. We placed order with purchasing agent for one set of tips, No. 1 to No. 7 complete, requisition for which should reach you within the next day or two.

I thank you for the instruction book, also for your offer to furnish information on handling difficult job. Would be glad to have you drop us a line a day or so in advance when you expect to make your next visit.

Yours very truly,

SAN DIEGO CONS. GAS & ELEC. COMPANY,

Sup't Shops & Stores.

CDW:AI

These are only a few of the points where *Victor* apparatus will be sold in the future.

Because wherever *Victor* goods are introduced they are there to stay—and repeat orders follow.

WHY?—Because *Victor Torches* do the most work for the least money and fulfill all promises made for them, as indicated by this letter.

Distributors Wanted. If you are the man you can build up a very profitable business selling Victor Apparatus. Eliminate the above cities and select your own territory.

Victor Oxy-Acetylene Equipment Company

10 North Jefferson St., Chicago, Ill. **884 Folsom St., San Francisco, California**

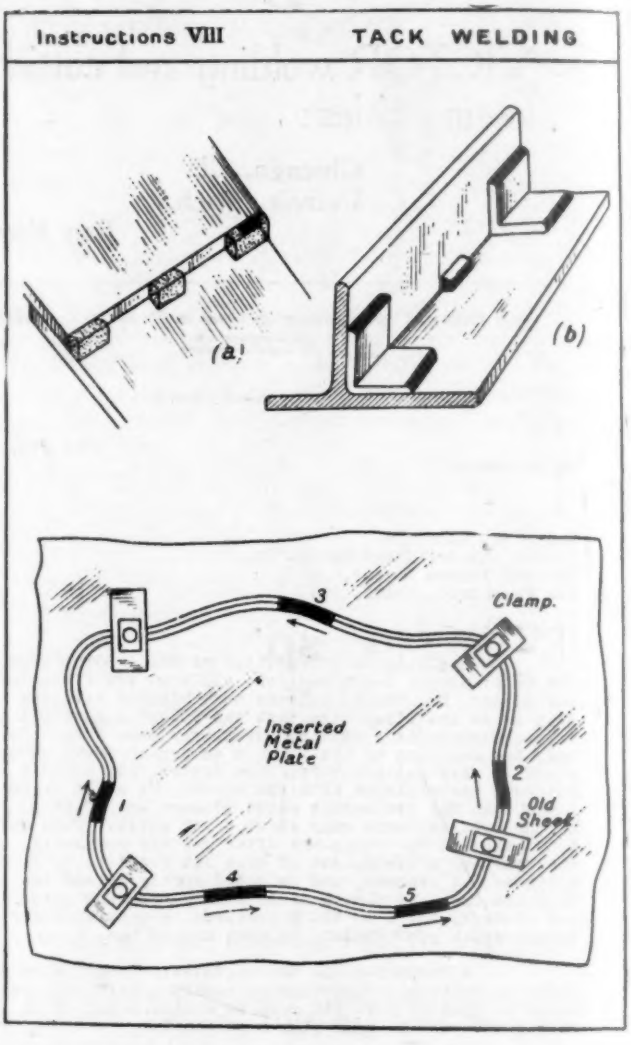
TACK WELDING*

TACK welding has been mentioned previously in various lessons, but as the success of nearly every intricate job depends on tack welding successfully, i. e., at least the ultimate alignment, and in some cases a whole job, it is important enough to practice separately. Tack welding, as shown in Figures A and B, is also used to replace riveting, i. e., the pieces to be joined do not require a total strength of a continuous weld, and the same amount of metal applied in a bead as would be applied in tack welding would not give equivalent results for rigidity or resistance to bending strength. Similarly for all tacking, a single bead all the way around can never equal the results of full tack welds applied simultaneously, or as soon after each other as is possible. The most difficult form of tack welding is the replacing of a section on the sheet in the firebox, which section is burnt out or damaged by some other means, i. e., as by cracking. In this case the damaged section is cut out so as to remove the entire damaged section and the part thought to be damaged and this removed piece is laid on to a new sheet of the same thickness and chafacter as the original sheet, and a piece exactly the same size cut out.

The outer edge of the new piece and the inner edge of the hole in the old piece are veed out so to form a single bevel, double "V," because, in general, only one side of a job of this character can be got at. The new piece is then held by clamps in place by inserting bolts with two faces of the head ground off flush with the shank, and sticking this head through a crack in the "V" and turned around 90 degrees a strap of plate metal with a hole in it with nut and washer. Frequent readjustment by trial of the new piece of plate until it is perfectly and rigidly in place, and you are ready for the tack welds. In the case of a sheet thus inserted in the firebox it would be very irregular, due to the sheet having been cut out to miss the staybolts. Everything should be ready now so that no interruption will need occur in the work, i. e., have the electrodes handy, and in sufficient quantity, and try out all adjustments before starting. In fact, all adjustments of machine, etc., should be tried out on scrap pieces and not in the weld, as it is obvious poor welding due to wrong adjustment may be included in the "V."

The best way to try out the machine is as outlined in first lesson, i. e., run a bead and tackle it with a chisel. Referring to the sketch a tack should be made as at Figure 1, from the bottom up, and the "V" completely filled up, paying especial attention to the bottom of the "V," and pointing of electrode to the sides, as in previous lessons. The back part should be kept filled in advance of the front, so that there is no danger of the metal running down ahead in the back and not being welded. Special attention should be paid to the welding of the bottom part of the "V," and much less damage results in a double "V," single bevel weld from burning through or depositing a slight bead on the inner side than from not burning through and leaving a void unwelded spot. This tack for a medium large sized patch, i. e., 1½ inch by 3 inch, should be 3 or 4 inches long. A similar tack should be made as soon as possible approximately opposite to the first one, before the contraction of the first one has caused the plate to be pulled out of place. A slight breathing spell, if desired, can now be taken before making tacks 3, 4 and 5 as near together as possible. Of course, if two men can work on this job they should do approximately opposite tacks at the same time. In making tacks 3, 4 and 5, i. e., horizontal welds, there is a choice of the two following methods:

To fill the "V" in at one time, or make one bead at the back to insure this being welded, and fill the rest of the "V" in at one time, or the following method of putting the bead at the bottom of the "V" first and then welding overhead on the upper edge of the "V" to be sure that this is welded, and then putting a layer on the bottom edge joining the other two beads at the same time, and then filling in with the rest of the metal to the level of the plate. For tack welding the first method is preferable, as it saves time and the weld



should be made as shown in Figure C, Lesson 4, with the top side behind. If the "V" is not exactly horizontal, proceed from the lowest side. After welds 3 and 4, or better yet, 3, 4 and 5, are made without cracking or pulling the plate out of place the tack welding at least may be pronounced a success, and the clamps removed, because if any of the welds are not perfect the contraction of the one opposite would pull the plate away. If the welds were all poor this would not happen, but the removal of the clamps would then show the defect by the plate falling.

In welding tanks, rectangular containers, such as oil and water containers, and, in fact, any joint shapes for any purpose, there is the choice of what is known as the rigid method or the aligning method. The method just described is the rigid method, i. e., the tacked spots are welded rigidly in place at all stages of the job and any strains are taken up by the plate or the weld.

The self-aligning method and its difficulties and faults are fully described in succeeding instructions.

---

*Instruction No. 8 from the handbook of the Electric Arc Cutting & Welding Co., 222 Halsey Street, Newark, N. J. Copies of the complete instruction book may be had from this company at $1.25 each.

Patented
Jan. 22, 1918
May 4, 1920

Approved by
Underwriters
Laboratories

WILLSON

Triangular Welding Goggle

No sparks can enter this goggle. The INDUSTRO LENSES keep out harmful light, and meet all safety code requirements by Bureau of Standards test.

The goggle allows unobstructed vision and is "roomy" enough to keep fresh air moving in front of the eyes. It is durable and can be sterilized by any method; never burns the face, and any part can be replaced without a tool. Perhaps you know this goggle by its other name, Style LI. Surely you know of its fine record and wide use in modern welding. Do you use it!

Price $300 per hundred (including metal cases), f. o. b. Reading, Pa.

Attach this page to your company letterhead
and mail to us for trial goggle.

Have you a Willson Catalog?

WILLSON GOGGLES INC., Factory and Main Office, Reading, Pa.

Chicago	San Francisco	New York	Pittsburgh	Toronto
Mallers Bldg.	Sachs Bldg.	Bush Terminal Sales Bldg.	Magee Bldg	23 Scott St.

NEW AIRCO PLANT

The Air Reduction Sales Company has just completed the construction of a four-story addition to its apparatus plant in Jersey City, N. J. This is to provide for the increased production of the Airco "A" Welding and "D" Cutting Torches to meet the rapidly increasing demand for this apparatus.

View of the Recently Enlarged Airco Apparatus Plant.

The extension has been built in accord with the principles of modern factory construction. It is of brick, with reinforced concrete floors. Careful attention has been paid to securing maximum lighting, and in every other way the comfort and safety of employees have been considered.

APPOINTMENT OF O. E. FALLS

O. E. Falls, who has had many years of experience in charge of Foundry and Thermit welding work at the Norfolk Navy Yard, Portsmouth, Va., has accepted a position with the Metal & Thermit Corporation, New York. Mr. Falls obtained his earlier foundry experience from posi-Roanoke, Va. The Richmond Locomotive Works, Richmond, Va., Pennsylvania Engineering Works, New Castle, Pa., The Franklin Air Compressor Works, Franklin, Pa., The Seaboard Air Line Railway Company's Shops, Portsmouth, Va.

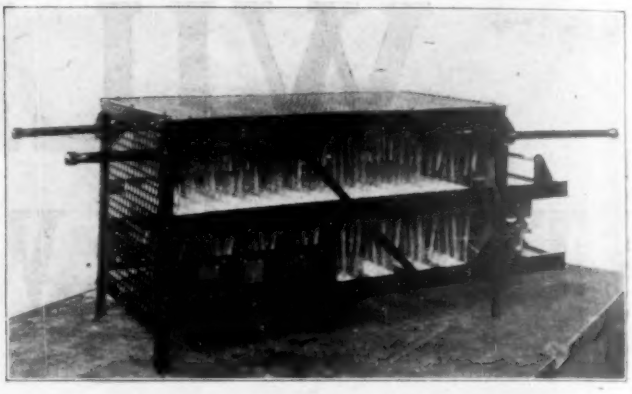
At the last mentioned company Mr. Falls began his first Thermit welding work. In 1905 he joined the Goldschmidt Thermit Company then located at 43 Exchange Place, New York. In 1907 Mr. Falls returned to the Norfolk Navy Yard and for 10 years did all or supervised the Thermit welding work of that company. This work included some valuable repairs made on battleships, torpedo boats and torpedo boat destroyers.

After leaving the Norfolk Navy Yard in 1917 Mr. Falls became superintendent in the steel foundry of the Bay View Foundry Co., Sandusky, Ohio. He was later appointed superintendent of the steel foundry of the Weatherley Steel Castings Co., Weatherley, Pa., and still later superintendent of the iron and brass foundry of the Gaskins Foundry Co., New Bern, North Carolina. He was superintendent of the iron and brass foundry of the Manning Manufacturing Company, Rutland, Vermont, when he accepted his present position with the Metal & Thermit Corporation.

AN ARC WELDER FOR RAIL BONDS

The General Electric Company has developed an electric arc welding equipment incorporating new features, and especially adapted for welding rail bonds on street or industrial railways. It is also applicable to welding work in industrial plants where loss of electrical energy is not objectionable.

The apparatus consists of a wire resistance unit, mounted in a light metal frame, with suitable leads for connecting to the power supply circuit and to the electrode holder. Switches provide a welding current with range of from 60 to 200 amperes, in 15 amp. steps.



A view of the G. E. Rail Bond Welder.

The complete device is light, easily portable by two men, and will not be injured by exposure to the weather.

The circuit is controlled through a contactor, operated by means of a push-button switch located close to the electrode holder. This arrangement permits the operator to open the circuit at a point remote from the weld and thus avoid flashing. This push-button switch is normally open so that the electrode holder is not alive unless the operator holds the switch closed by pressure from his hand or foot.

TESTING WELDS

A new method of testing the ductility and tensile strength of metals has been developed by Mr. James W. Owens, welding aid of the Norfolk Navy Yard. It consists of cutting from the metal to be tested a ring-shaped specimen and bursting it in a specially designed apparatus. This apparatus is being manufactured by the Tinius Olsen Testing Machine Co., of Philadelphia, and can be used in any standard tension testing machine. The utility of this test is primarily due to the small size of the specimen and the ease with which it can be obtained. It was used successfully for testing the butt joints of the arc welded battle towing target built at the Norfolk Navy Yard.

CORRECTION.

In an article relating to the brazing of steel tubes, which appeared in the November issue of The Welding Engineer, an error occurred which may have caused some of our readers confusion in comparing the illustrations with the text. The text should be changed to read, "Figure 4" for "Figure 1," "Figure 1" for "Figure 2," "Figure 2" for "Figure 3" and "Figure 3" for "Figure 4." Figure 5 is correctly referred to as showing the inside of a brazed pipe joint.

Acetylene 1¼c per foot

If you generate it with a

MECO

Type CG Stationary Automatic Acetylene Generator

Made in 25-lb., 50-lb., 100-lb., 200-lb. and 300-lb. Capacity

Write for prices and literature

Modern Engineering Co.
23rd and Walnut Sts., ST. LOUIS, U. S. A.

We Can Save You Money On GAS and OXYGEN

USE

WELD Trade A Mark CAST FLUXES

"Weld-a-cast" is a scientific combination of chemicals, that causes the metal to melt rapidly shortening the operation, thus economizing in time, gas and oxygen.

"Weld-a-cast" adheres readily to the hot welding rod which picks up just enough and none is wasted; it does not blow away but melts at once; it eliminates blow holes and leaves the metal soft.

Write for Free Samples

CORTLAND WELDING COMPOUND CO.
CORTLAND, N. Y.

Genuine Swedish Lancashire Charcoal Iron Bars

FEDERAL TOOL & ALLOY STEEL CORPORATION

Genuine Swedish Lancashire Charcoal Iron Welding Wire

Best Swedish Brands

Immediate Shipments From American Stocks

There is no substitute for Genuine Swedish Lancashire Charcoal Iron on the score of quality

FEDERAL TOOL & ALLOY STEEL CORPORATION

Thomas Towne, 1st Vice-President and Gen. Mgr.

General Office :
Woolworth Building - NEW YORK CITY

Branch Offices and Warehouses:
66 Rutledge St., Brooklyn — 1280 Ontario St., Cleveland
654 W. Lake St., Chicago — 849 Commerce St., New Orleans

WELDOX

Asbestos Welding Paper

Send for a Free Sample

IT'S especially made for you—for the welder, not for the casting. Not the ordinary paper manufactured for many uses, but a scientifically prepared, long-fibre, pure asbestos paper developed for one purpose—to furnish a welding paper capable of withstanding hard usage and high temperatures without giving off noxious and injurious smoke, gases and fumes. Your men naturally can do better work when WELDOX Asbestos Welding Paper is used on every welding job.

WELDOX Asbestos Welding Paper comes in 50 lb. and 100 lb. rolls, 36 inches wide.

Test the Free Sample with a torch. Subject it to physical tests. "WELDOX" in your shop and available for every job will save in many ways: It lasts longer; it cuts out eye and lung sore for the welders; it therefore aids in turning out better work in less time.

All rolls specially wrapped, and labeled "Weldox"

Asbestos Mittens, plain or one finger and thumb.
Asbestos Mittens, 23-inch length over all.
Asbestos Gloves, 5 fingers.
Asbestos Leggings, 16-in. to 30-in. lengths.
Asbestos Aprons, made to specifications.
Asbestos Masks.
Asbestos Fibres.
Asbestos Cloth.

If it's Asbestos, we have it.

F. D. Farnam & Co.

359 N. Wells St., Chicago, Ill.

OXY-ACETYLENE AIDS HUGE ENGINEERING PROJECT

TO the lay reader the most interesting engineering feature of Butt's new 28-mile water pipeline, recently completed at a cost of something more than a million dollars, is the fact that it carries water from the Atlantic watershed to serve a city on the Pacific slope.

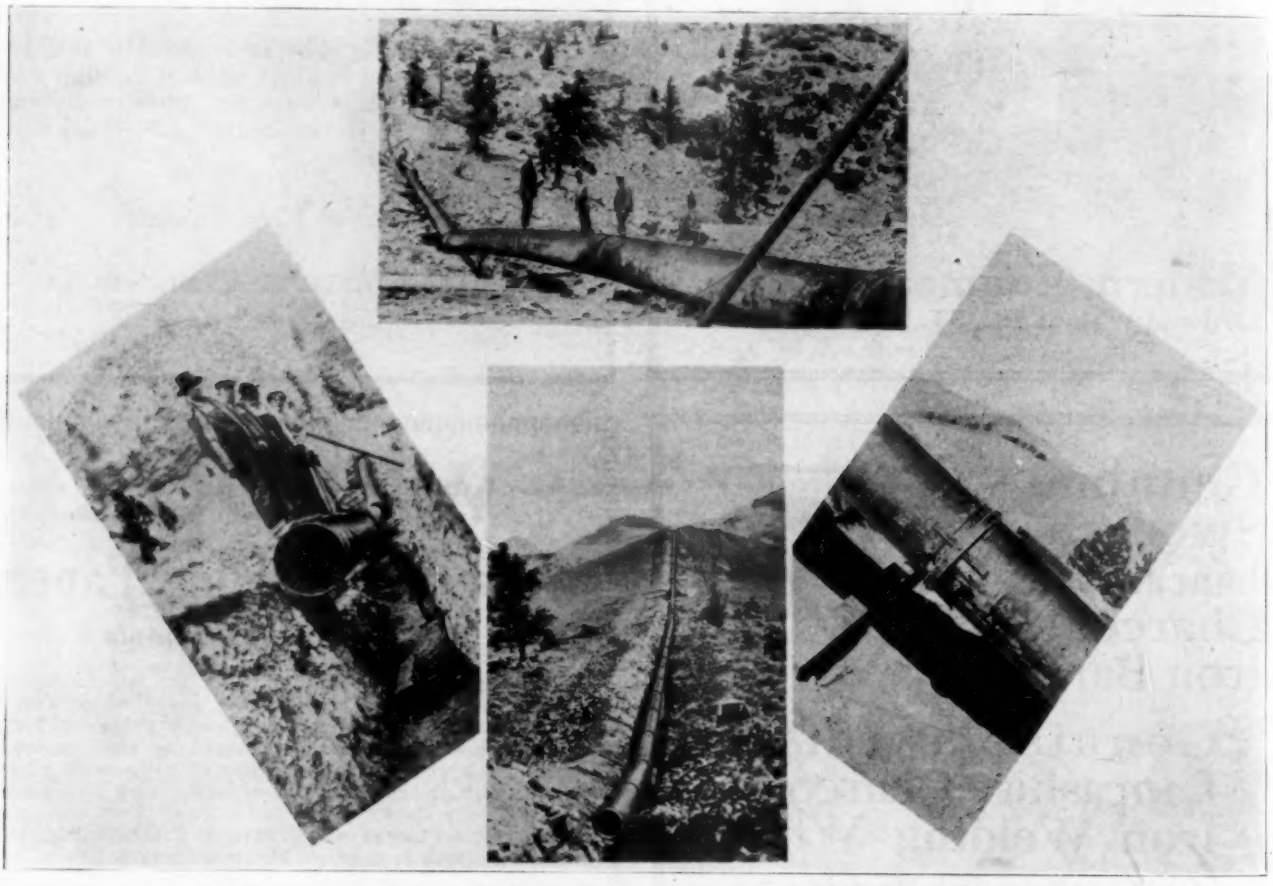
Hydraulic engineers, however, are more interested in the constructional difficulties encountered and overcome, and this relates not only to surmounting topographical obstacles, but even more to some of the other vital and unusual problems. Chief among the latter were: that of providing means permitting specification of wooden stave pipe for the greater extent of the line; and that of determining the best means of making joints in the steel pipe where the higher pressures made the use of steel pipe necessary.

The use of oxy-acetylene welded, instead of riveted or screwed joints is one of the most important features of the Butte project from an engineering point of view, as it tends to stress a tendency that is more and more becoming a definite and permanent departure in pipeline construction, both in and outside the hydraulic field. This interesting phase of the engineering on the Butte aqueduct will be dealt with after disposing briefly of a few non-technical details.

The project presented unusual physical obstacles. In places the line climbs abrupt slopes, threads tunnels through solid granite, and clings to sheer mountain walls. In one place a 10-horse team used in an effort to haul a three ton "T" had to be abandoned and block and tackle substituted. Caterpillar tractors, auto trucks and ponderous excavating machinery were in constant use. Where grades were too steep for trucks, horses were pressed into service, and where they could not negotiate the climb the caterpillars were hooked on.

The new pipeline duplicates the old line (in service since 1900) and was built to supplement, not to replace it, excepting during periods when repairs to the old line became necessary. The new line is composed partly of steel-banded redwood stave pipe, and partly of ½" thick, double-coated pipe, the sections being on the average 17½ feet in length and weighing from 2,000 to 2,400 pounds, according to diameter. The wood pipe is used up to a hydrostatic pressure of 300 pounds per square inch, and the steel pipe for pressures in excess of 300 pounds. There are approximately five miles of the steel pipe in which the working pressures vary from 350 to 400 pounds per square inch. In one place a grade of 38 degrees is maintained for a distance sufficient to elevate the line 400 feet, and there is a lift of 800 feet in a distance of 3,000 feet—from pumping plant to standpipe.

This standpipe, which is made of concrete and stands 75 feet high, was erected at the same elevation as the "South Fork" reservoir, some nine miles distant, its function being to take up the "water-hammer" in the pipe. The water rises or falls in the standpipe with each stroke of the pump, thus equalizing the pressure on the line.



Oxy-Acetylene Welding Made Possible the Economical Construction of this Huge Pipeline.

It is claimed that the great pumps, three in number, are the largest ever built, and that but one pumping station in the world lifts a column of water to a greater height. The three pumps are capable of delivering 15,000,000 gallons of water every twenty-four hours. Besides this volume, the South Fork reservoir receives daily 1,000,000 gallons drawn from the south fork of Divide Creek, bringing Butte's total available supply up to 16,000,000 gallons per diem.

Following are some interesting material and constructional data relating to the completed line:

26-inch Oxy-acetylene Welded Pipe..... 3,674 feet

WELDING RODS

Parsons' Manganese Bronze Rolled Welding Rods

the Strongest Bronze Made

for high-fire Brazing and Oxy-Acetylene Welding of Malleable Iron or Bronze and Brass castings assure a faultless, flawless job. This is another example of the "Cramp" standard of quality. This scientifically perfected metal is the result of long years of experience. Its fine physical properties make it especially suitable for welding purposes.

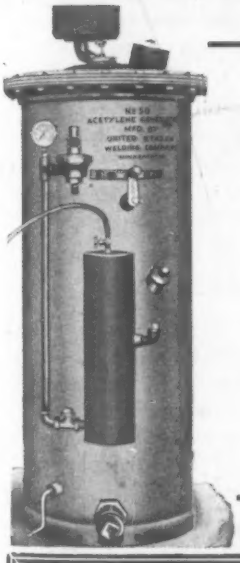
A strong weld of fine close grain and exceedingly tough texture is always the result where Cramp's Welding Rods are usesd.

We can also furnish Welding Rods of Cramp's Cast Iron, Cramp's Copper Covered Iron, Cramp's Vanadium Steel, Cramp's Drawn Aluminum, Cramp's Cast Aluminum, Cramp's American Iron and Soft Brass Brazing Wire.

CRAMP

We furnish and will be glad to estimate on all kinds of brass and bronze castings.

The William Cramp & Sons Ship & Engine Building Co., Philadelphia



Are You Prepared?

You may have the finest welding or cutting equipment in the world and yet not be prepared to give prompt service if without gas. Acetylene generators eliminate the possibility of ever being out of gas.

"U. S." Generators are so simple that a boy can operate; are extremely efficient and will save about 80 per cent of your acetylene bill. They will operate any make of welding or cutting apparatus.

A machine to make 150 cubic feet per charge.....$175

(Made in various sizes. A card will bring full particulars.)

UNITED STATES WELDING CO.

(Dealers Territory Open) **Minneapolis, Minn., U. S. A.**

Campbell's "Oxy-Acetylene" Welding Manual

By Lieutenant Lorn Campbell, Jr.
Ordnance Corps, U. S. A.

Lieut. Campbell organized and conducted the Army Welding School at Peoria, Ill. His new manual is based on his experience there, in training soldier welders. 154 pages, 89 illustrations, bound in cloth, $1.25.

THE WELDING ENGINEER
Chicago, Ill.
608 S. Dearborn St.,

CONTENTS

Introduction.
I. Apparatus.
II. Operation.
III. Shop Equipment.
IV. Apparatus repairs.
V. Preheating Agencies.
VI. Part One—Welding of Cast Iron.
Part Two—Welding of Cast Iron.
Part Three—Welding of Cast Iron.
Part Four—Welding of Cast Iron.
VII. Part One — Steel Welding.
Part Two — Steel Welding.
Part Three — Steel Welding.
Part Four — Steel Welding.
VIII. Brass Welding.
IX. Part One — Aluminum Welding.
Part Two — Aluminum Welding.
Part Three—Aluminum Welding.
X. Welding of Malleable Iron.
XI. Oxy-Acetylene Cutting.
XII. Carbon Burning.
Glossary.
Index.

24-inch Oxy-acetylene Welded Pipe	22,368 feet
Total Oxy-Acetylene Welded Pipe	26,042 feet
26-inch Steel-Banded Redwood Stave Pipe	42,326 feet
24-inch Steel-Banded Redwood Stave Pipe	71,954 feet
Total Redwood Stave Pipe (lineal)	114,280 feet
26-inch Gate Valves	(No.) 9
24-inch Gate Valves	(No.) 9
24-inch Balance Float Valves	(No.) 4
Concrete Float Valve Chambers	(No.) 4
Concrete Weir Champer (at *Reservoir* in Butte)	(No.) 1

The construction of the pipe line required 1,125 tons of steel pipe; 1,750,000 board feet of redwood staves; 1,000 tons of steel bands (used on the redwood pipe); and 426,000 malleable shoes, weighing from 6 to 8 pounds each for the wooden pipe construction. There were 160,000 cubic yards of excavation, including earth, loose rock and blasting.

Why the Line Was Welded

The reason for using welded construction instead of the customary riveted or screwed connection is primarily one of efficiency, though it also resulted in a marked economy. To have secured the same strength in the joints with screwed pipe, very much heavier pipe would have been required, and if riveted pipe had been used lapping the joints would have been necessary. In either of these cases the material cost for pipe alone would have been considerably higher than it was. The labor cost of the welded construction, everything considered, was also lower than it would have been for screwed connections. Another great advantage was a greater flexibility of the welded joints, which readily yielded to conform to the contours of the trenches. Flexibility is highly important in a country where many sharp curves must be followed. Another consideration was the advantage in speed of construction—an important element in this work, where an average of 350 men were employed over a continuous period of five months. It was very important also to have the work completed in the early fall before the rigors of winter should halt it entirely and this might not have been possible had it been handled differently. But, were there no other consideration, the fact that the steel pipe lines embedded several feet under the surface where the joints are exposed to seepage from rain and snow and to the attack of rust, would be conclusive in determining an engineer today on using some form of welded construction, owing to the unquestioned ultimate economy of this method of jointing.

The process employed in welding the pipe was given very careful consideration, and it was decided that oxy-acetylene welding would insure the best jointing of the pipe to stand up under the service for which the line was designed. It then became merely a matter of awarding the work to a responsible welding contractor, having standard equipment and employing competent welders. The welding was done under the superintendence of F. E. Woodbridge of Butte and Helena.

How the Welding Was Done

The method of welding the steel pipe is very interesting. Joints were lined up by means of pump jacks and held in position by steel clamps made of ¾-inch strap steel three inches wide. The joints were then tacked in four places, after which the operator proceeded from any one of the tacks as a starting point. It was possible in many cases to turn jointed lengths 200 feet long to 300 feet long at one time, thus enabling the welder to operate continuously on top of the pipe. Where long curves were necessary many of the joints were made by the operator welding around the pipe in place, but supported on skids, thus eliminating the necessity of excavating bellholes in the solid rock which would have been very expensive.

The curves were very numerous on this work and the joint construction was so carried out as to distribute the bend over several connections, a small amount being allowed for each weld. This not only gave the line a graceful appearance, but reduced friction to a minimum, which is one of the great points in favor of welded construction. Owing to the fact that the pipe will carry water to its full capacity the year round, the expansion and contraction are practically nil, but as a safety measure where the curve occurs in the line or the pipe descends or mounts an incline, additional curve is allowed to provide for such expansion and contraction as there are.

Lowering Pipe into Trench

The pipe was suspended over the ditch by 8x8" skids for distances of from 300 to 400 feet and when ready for the trench, one end was slightly raised with the pump jacks to allow removing the skids at that point, when the unsupported end was allowed to drop into the ditch. The succeeding skids were then taken out in a similar manner and succeeding sections of welded pipe were thus lowered to the bottom of the trench. In some cases there were as many as seven joints suspended between the point of the jack and the first skid, causing a total strain of approximately seven tons on one of the joints. It will be noted that one of the photographs shows four men at the end of a pipe section in mid-air by means of a chain block placed back of the joint. The full weight of the pipe and of the four men (approximately 2,800 pounds) comes on the joint in this case, visually indicating the great strength of a joint where properly welded by the oxy-acetylene process.

In some cases, when the wind was very severe, shelter was necessary for the flame as air currents tend to cause oxidation. Very little trouble was experienced, however, regardless of the weather, and the welding measured up to every inspection requirement.

It will be appreciated, of course, by those familiar with oxy-acetylene work that it was very necessary to have the metal clean and free from foreign substances and to avoid using an excess of either of the gases, as the pipe in this aqueduct has to withstand heavy pressure.

PORTABLE DRILLS AND GRINDERS

A folder recently issued by the Wodack Electric Tool Corporation, of Chicago, describes the Wodack line of portable electric drills and grinders. These handy little machines are equipped with universal type motors for alternating and direct current. The switch, located in the handle, shuts off the current the instant the pressure is released, so the operator has good control. The illustration shows the Wodack portable electric grinder. Its uses in the welding shop will readily suggest themselves, because there are so many repair jobs that must be finished nicely and it is impracticable to finish anything except light pieces on a stationary grinder. This grinder weighs only thirteen pounds and can be used for smoothing down, buffing and polishing.

A Thirteen-Pound Grinder.

Renewal Not-Repair

The Lawrence Patent process is the only way of economically—and dependably—repairing your scored cylinders.

It is fully protected by its patents—and in vital respects differs entirely from any apparently similar methods of achieving the same end. It has never been known to fail; no scored cylinder repaired by the Lawrence process has ever given out.

Service Stations Thruout United States

Full particulars for representation in open territory upon request

Established SCORED CYLINDER TRADE LAWRENCE MARK PATENT PROCESS *1862*

Woolworth Bldg. **L. LAWRENCE & CO.** New York City

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Wanted—Salesmen, Demonstrators, Welders and others meeting the welding trade to solicit subscriptions to *The Welding Engineer*, or furnish names of possible readers. When you put your friend or customer in touch with this publication you do him a real favor—make it possible for him to learn more about autogenous welding, liberal proposition. Write me now. Yours for welding, Mackenzie.

Increase your earning power by making your own **fluxes.** Think of the cash **you** can save. Write today for prices on our **guaranteed flux** formulas. American Flux Company, Box 153, Madison Square Station, New York City.

Shops not equipped for heavy work should co-operate with Chicago Welded Products Co., 226 N. Carpenter St., Chicago, Ill. Oxy-Acetylene and Electric Welding. Prices reasonable.

For Sale at a Bargain—One Oxweld welding outfit, slightly used; factory polish is not yet worn off. Also one Airco acetylene cylinder. Standard Welding Works, 1355 Bellows St., Akron, Ohio.

AGENTS WANTED.

We have a few territories still open for the sale of the WELDIT line of approved welding and cutting apparatus. Attractive discounts. We will pay cash for Prest-O-Lite Acetylene cylinders.

WELDIT ACETYLENE CO., 414 W. Grand River Ave., Detroit, Mich.

WELDER WANTED FOR CUBA

There is a chance down in Cuba for a thoroughly competent shop or job welder to establish himself with a large company. He should be young, and the ability to speak Spanish would be to his advantage. He must be a student of his business, a skillful, willing worker, and temperate in his habits. Such a man can have a good salary with a contract for one year, or possibly two years, and will be furnished with transportation to Cuba.

Address 36, care The Welding Engineer.

The Histed Novelty Goggle

FOR WELDERS

is attached to the welder's cap by means of two little spring clips that clamp to the visor of the cap and hangs clear of the face, thus avoiding the possibility of the face or nose being blistered by the hot metal touching the skin. The lenses are 2 inches in diameter, which gives ample eye protection and prevents the welder looking past the lens when welding overhead. Good ventilation is assured by the Goggle not being enclosed and admitting plenty of light, thus keeping the eyesight normal at all times—that is, not dilated as in enclosed Goggles. No moisture from perspiration can gather on lenses, thus keeping vision clear, adding materially to the welder's efficiency. When inspecting work, the Goggle may be swung to a raised position and back quickly, without loss of time at welding, or removing gloves, or laying down torch or welding rod—a great advantage over those using the elastic head-band or ear-bows. When Goggles are not in use they are swung to a raised position and held in place by spring, and may be worn on cap visor at all times without inconvenience. They are always ready and stay nicely in place, whether welding down or overhead.

Patent Allowed—April 3, 1919.
The Goggles are supplied with the "Wilson Industro Lenses" in any degree of density desired. Practical welders can't speak too highly of the

HISTED NOVELTY GOGGLE

Sent to any address in the United States for $2.50 per pair postage prepaid. $24.00 per Dozen.

J. E. HISTED
2609 Marshall Ave
Newport News, Virginia

Experienced Welder would like to connect with reliable firm as demonstrator; or as a partner in welding shop. Address 37, care The Welding Engineer.

Wilson Welder with operating panels for two men; in first class condition. Address 38, care The Welding Engineer.

Welders Save Money—Make your own Cast Iron Brazing and Aluminum Flux. The better kind. Satisfaction three. Pacific Flux Co., 18 Natoma St., San Francisco, Calif.

CURRENT WELDING LITERATURE

CAST IRON CUTTING WITH THE OXWELD BLOWPIPE.—More acetylene is used in the heating flame, and the torch tip is held farther away from the metal than in cutting steel. It is also necessary to develop an oscillating movement to get the best results. Article includes chart of pressures for various thicknesses of metal.—The Acetylene Journal, December.

MELTING AND CASTING OF BRASS, by David Baxter.—Brass must always be melted in a specially made crucible, which must be heated all over until it is almost at the melting point. The most convenient way is to build a firebrick furnace around it. The clever welder can make a great many of his own brass castings.—The Acetylene Journal, December.

REPAIRING GEARS WITH THE OXY-ACETYLENE FLAME, by David Baxter.—A small cast iron gear with several teeth broken is taken as an example of gear repairing. Preheating allows the use of a smaller torch and lessens the danger of contraction strains.—American Blacksmith, November.

SPOT AND ARC WELDING, by H. A. Horner.—Published by the J. B. Lippincott Co. The author has carefully compiled the information concerning spot and arc welding that has been made available by the researches of the Emergency Fleet Corporation during the war. His book supplies the need for concise, readable treatments of the metals most commonly welded. The discussions of both these electric welding processes are frank and unbiased, and they will be valuable to practical men who wish to investigate the possibilities of electric welding in a large scale. Those who are already using these processes will find in the book some of the best instruction available, and a great deal that is valuable concerning the electric and metallurgical theories involved. In the appendices there is a splendid collection of articles on machinery, materials and methods. The book is well illustrated with photographs and diagrams.

CUTTING CAST IRON WITH THE OXY-ACETYLENE TORCH.—The Air Reduction Sales Company has just printed and now has ready for distribution a booklet entitled "Cutting

Season's Greetings

At the close of our most successful year—a year chock full of activity and good business—we wish to thank the readers of The Welding Engineer for their splendid patronage. Our slogan has been, as it shall always be:

"He profits most who serves best."

A LINE SECOND TO NONE

REGO Apparatus for Welding and Cutting
Acetylene Generators
Filler Rods
Preheating Torches and Ovens
Cylinder-Apparatus Trucks
Aerial Grinders
Asbestos Wearing Apparel
Welding Tables
Electric Welders—A. C. and D. C.
Supplies
Accessories

Manufacturers Electrolytic Oxygen and Hydrogen

Ours is the first Oxygen Plant in the United States to secure the approval of the
UNDERWRITER'S LABORATORIES, INC.
and the right to use its name together with the word "inspected" with respect to our plant, its operation and products.

Write for our latest price list and catalog.

KENTUCKY OXYGEN-HYDROGEN CO.

INCORPORATED

LOUISVILLE 1416-24 Magazine Street KENTUCKY

Finish Your Welds with a "WODACK" Portable Electric Grinder

It quickly and easily smooths off welded joints. And it has a hundred other uses in your shop, such as buffing and polishing.

Completely inclosed universal type motor. A. C. and D. C.—4x1x⅞ in. Grinding Wheel.—Weight, 13 lbs.—Furnished with 10 ft. extra heavy flexible cord and one Grinder Wheel.

WODACK Electric, Tool Corporation
27 South Jefferson St., Chicago, U. S. A.

Use FLUXINE for Brazing

It flows rapidly without bubbling, brazes at a lower temperature, and requires less spelter than borax or boracic acid.

You can make a solid joint that requires no filing, with 1¼ lbs. of **FLUXINE** and 12 lbs. of spelter.

FLUXINE cuts your spelter bill in two.

FLUXINE has been giving satisfaction for over 26 years.

DEALERS:—Write for agency proposition. FLUXINE is a "repeater".

Manufactured Exclusively by
KREMBS & COMPANY
173 N. Green St. CHICAGO, ILLINOIS

Cast Iron with the Oxyacetylene Torch." This booklet, attractively illustrated, is a reprint of a paper on the subject prepared by A. S. Kinsey, Professor of Shop Practice, Stevens Institute of Technology, for the recent meeting of the American Foundrymen's Association. It completely covers the subject of cutting cast iron by the oxy-aceteylene flame, tells how the cut is made, gives necessary pressures of oxygen and acetylene for varying thicknesses of metal, describes the advantages to be obtained from the use of the torch for cast iron, the economy as compared with other methods of cutting, etc.

THERMIT WELDING MILL AND FOUNDRY PAMPHLET.—The Metal & Thermit Corporation, New York, has just issued and will distribute on request the Third Edition of the Thermit Welding pamphlet No. 17 for mill and foundry repairs. The new edition has been revised and brought up to date both as regards new practices recommended and illustrations showing recent interesting repairs on certain types of equipment which were executed since the publication of the former edition. The pamphlet begins with a general discussion of the proper applications and fields for Oxy-Acetylene, Electric and Thermit Welding, respectively. It then describes in detail the methods to be followed and apparatus used in welding iron and steel sections in general. Later it outlines thoroughly special applications of Thermit welding, such as for crankshaft, pinion and roll repairs and also for cast iron welding. Not previously included in former editions of this pamphlet is a description of a new method of welding teeth in pinions. The pamphlet concludes by explaining the various applications of Thermit in foundry practice, such as for increasing the temperature of iron and steel, facilitating the introduction of other metals which it is desired to alloy for special purposes, making semi-steel in the ladle, keeping metal and risers liquid for a considerable period and making small steel castings.

THERMIT RAIL WELDING PAMPHLET.—The Metal & Thermit Corporation, New York, has issued and will distribute on request a new and revised Thermit Rail Welding pamphlet, No. 39, which describes the various ways in which Thermit welding can be advantageously used for rail welding, such as for eliminating rail joints and track maintenance expense in ordinary paved track, for making low cost and low maintenance frogs and crossings, for repairing motor cases and truck frames and for welding steam railroad rails in paved streets or where main highways cross the tracks, thus avoiding maintenance costs at these points caused by opening up the pavement at frequent intervals when bolts work loose or when the joints otherwise required attention. The pamphlet describes new phases and advantages secured by Thermit welding, which have not been covered in any previous booklet.

THERMIT CARBON-FREE METALS AND ALLOYS PAMPHLET.—The Metal & Thermit Corporation, New York, has issued the Fourth Edition of its Thermit Carbon-Free Metals and Alloys Pamphlet, No. 20. The phamphlet in addition to containing a detailed description of the properties and characteristics of the various carbon-free metals and alloys manufactured by this company, includes also for the first time an explanation of the advantages of using Tungtabs or tablets of pure tungsten metal, in the production of high speed steel and other alloys containing tungsten instead of using tungsten powder and ferro tungsten. By using Tungtabs mechanical losses which occur during shipping, sampling and storing the material, also in weighing up the charges, are reduced because of the uniform size of the tablets and their freedom from dust. Furthermore, metallurgical losses caused by oxidization in melting and by the absorption of tungsten by the crucible and electric furnace lining, particularly in the initial heats, are reduced because by using Tungtabs the melting time is decreased and there is a higher recovery of the tungsten owing to the fact that the Tungtabs melt down with the charge.

AUTOMOBILE WELDING

With the OXY-ACETYLENE FLAME By M. Keith Dunham

167 Pages* Price $1.50 *Fully Illustrated

This is the only complete book on the "Why" and "How" of Welding

Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone.

Gives principles never to be forgotten. Aluminum, cast iron, steel, copper, brass, bronze and malleable iron are fully treated, as well as a clear explanation of the proper manner to burn the carbon out of the combustion head.

Automobile Owners, Garage and Service Stations, Blacksmiths and Machine Shops, as well as industries using the oxy-acetylene flame, will find this book of the utmost value, since the perplexing problems arising when metal is heated to a melting point are fully explained and the proper methods to overcome them shown.

CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.
Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator — Creeping Regulators — Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.
Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.
Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases — Babbitted Bearings — Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.
Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold—Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case—Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.
Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding — Case Hardening — Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS, BRONZE.
How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Braze—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.
Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

CHAPTER VIII.—HOW TO FIGURE COST OF WELDING.
Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

Sent to any address Postpaid on receipt of $1.50 **THE WELDING ENGINEER** 608 So. Dearborn St. CHICAGO ILLINOIS

Bermo Welding Plants
OXY-ACETYLENE
13 years successful record
Guaranteed. Write for Catalog and Easy Terms
$25 to $250
Bermo Supply Co., Omaha, Neb.

ASK HYDREX
HOW TO TAKE THE GUESS OUT OF GAS WELDING
HYDREX ENGINEERING CORP., -- BUFFALO, N. Y

Electrolabs **Systems**

of Levin Cells

will furnish you Oxygen that is

99.8% Pure

at a fraction of the cost of "bottled" gases.

Each **Levin Cell** is a complete unit, strongly and simply constructed. A **Levin Cell** installation is a safe and economical gas supply. It is also **flexible.** New units can be added to meet the demand for more gas.

We are prepared to deliver complete installations of any desired capacity.

The Electrolabs Company

2635 Penn Avenue, Pittsburgh, Pa.

Electrolabs

ELECTROLYTIC GAS SPECIALISTS

Branch Offices

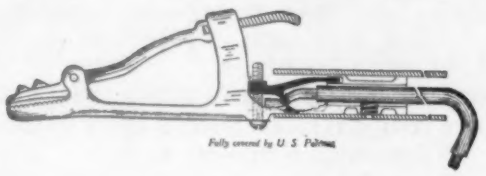
30 Church Street New York City — Morris Building Philadelphia, Pa. — Merchants Exchange Bldg. San Francisco, Calif.

Under the Technical Supervision of Electrolytic Oxy-Hydrogen Laboratories, Inc.

Attention Electric Welders

The First Real Electrode Holder on the Market

THE UNIVERSAL



Positive grip through both jaws, universal grip between jaws. Length 12 inches. Weight 1¼ lbs. Air cooled handle.

Constructed of manganese bronze and wood fibre. Hand does not come in contact with metal while welding.

A saving of 75% of time by the trigger release of hot waste material.

In feeding or installing new electrode, operator's hand never comes in contact with hot metal.

For Sale by All Leading Jobbers

MANUFACTURED BY

ROY O. WILLIAMS

946 Livingston Ave. Columbus, Ohio

Equipment for All Purposes

CUTTING TORCHES which use any preheating gas.

INJECTOR TYPE WELDING TORCHES

EQUAL TYPE WELDING TORCHES

REGULATORS THAT REGULATE

TORCHES MADE SPECIAL FOR GAS MANUFACTURERS

The Harris Calorific Co.

PIONEERS

Cleveland, Ohio

Manufacturers of

SEAMLESS STEEL CYLINDERS

For:

Oxygen
Hydrogen
Blaugas
Butane

Interstate Commerce Commission Specifications

RIGHT · PRICES—PROMPT DELIVERIES—SUPERIOR SERVICE

Wm. Wharton Jr. & Co., Inc.

[Founded 1859]

Gas Cylinder General Sales Offices

30 Church St., New York City

DISTRICT OFFICES:

Boston, New York, Scranton — Chicago, Philadelphia, San Francisco — Pittsburgh, Cleveland

ALUMINUM SOLDER

ALLWELD

This is not intended to entirely replace aluminum welding, but a real aluminum solder is a most desirable asset in the welding shops. All detrimental characteristics of so called Aluminum Solder are eliminated. Write for sample.

ALLOY WELDING PRODUCTS CO.
30 Church Street, N. Y.

Superior Brazing Compound

A product of years of time and study. Over 98 per cent pure boron. Its use is not attended by deposit or scale. Acts as a superior flux and purifies the brazing spelter, causing spelter to flow evenly into every part of joint, without deposit, scale or enamel. A trial will convince the experienced welder of the merits of Superior Brazing Compound.

If your dealer cannot supply you, we will.

Standard Mfg. Co.
318 S. Canal St., Chicago

SMOCK KEROSENE TORCH

439 Mass Avenue Indianapolis, Indiana

Our big man's yet a trifle small compared with this one order of

"Morey Flux"

This particular one is for welding of aluminum.

Morey Flux and Chemical Company
Parkesburg, Chester County, Penn., U. S. A.
Est. 1912 Inc. 1915

WELDING RODS

High Silicon Cast Iron

ATLAS QUALITY
Swedish Welding Wire

Special Prices to Jobbers
Inquiries Solicited

ATLAS FOUNDRY COMPANY
Irvington, New Jersey

TORCHES ACETYLENE GENERATORS
REGULATORS ELECTRIC WELDERS
GOGGLES
TANK TRUCKS PREHEATERS
HOSE
CAST IRON ROD
STEEL ROD
FLUXES BRAZING SPELTER
BRAZING NICKEL ROD
CAST IRON TOBIN BRONZE
ALUMINUM ALUMINUM ROD

WE REPAIR EQUIPMENT OF ANY MAKE

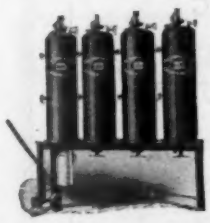
The Buckeye Welding & Supply Co.
1544-52 W. 6th St. Main 5476 Cleveland, O.

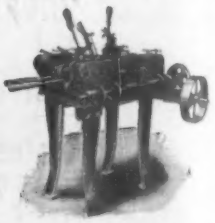
Aeroil Hand Preheating Torch

Heat as you want it where you want it when you want it

Agents Wanted

Aeroil Burner Co., Inc., Union Hill, N. J.





High Silicon Cast Iron Welding Rods

Cast Aluminum Rods.
Grey Iron and Aluminum Castings of all descriptions.
WHOLESALE ONLY.
WRITE FOR QUANTITY PRICES.
The Iron City Foundry Co. Hamilton, Ohio, U. S. A.

The Oxy-Thermalene Method of Welding, Cutting, Brazing, Etc.

ACETYLENE OIL GAS PRODUCER the gas of greatest efficiency, economy and SAFETY. The only class of its kind. Saves 25% on gas and oxygen.

FIRST CLASS REFERENCES
Special Welding MACHINES, guaranteed no flash back cutting and welding torches, and supplies.

The Thermalene Co., Chicago Height's Ill

AIRCO OXYGEN
AIRCO ACETYLENE
AIRCO SERVICE

AIRCO

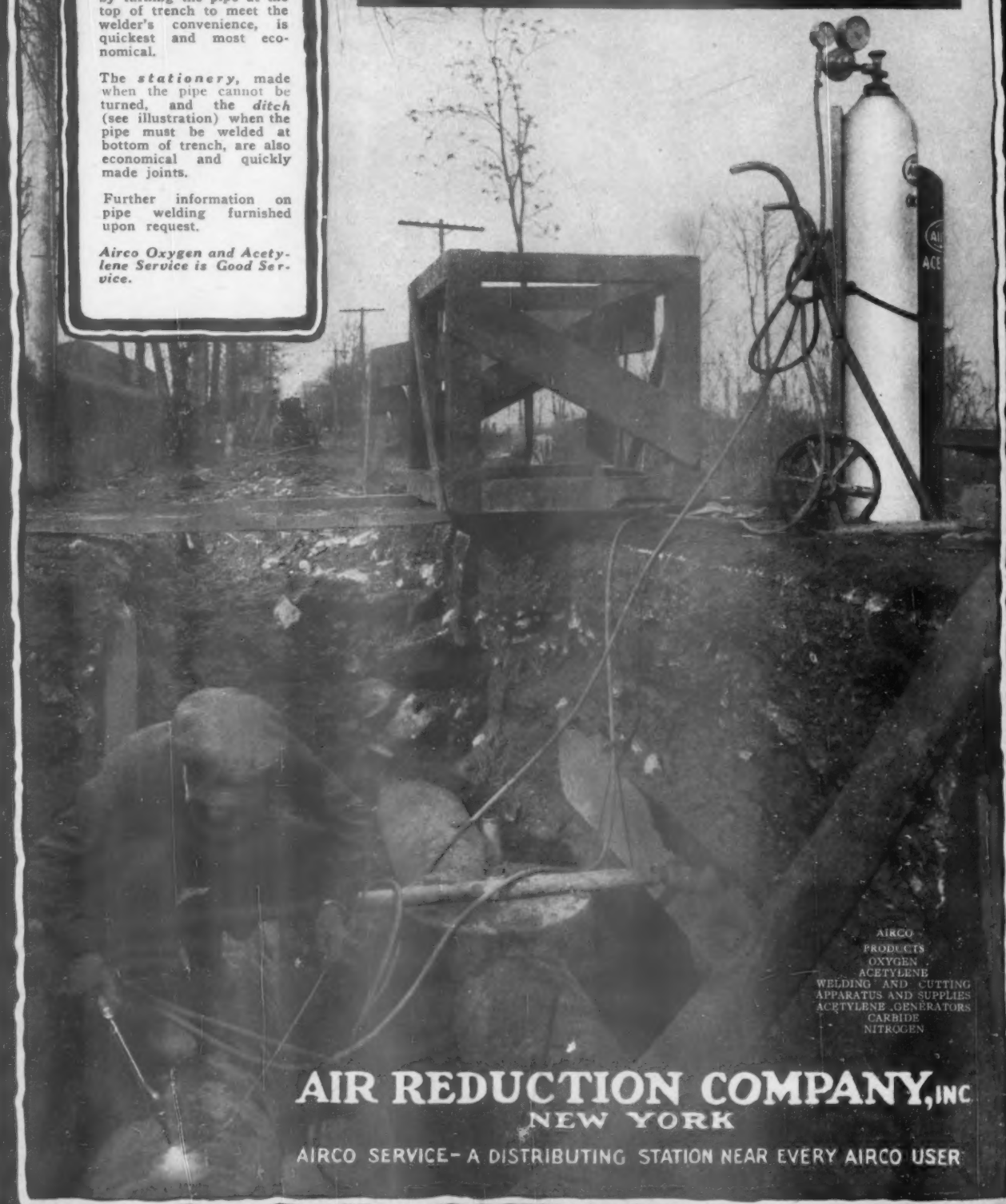
Oxyacetylene Welded Joints in Heavy Pipe Mains

The *turning* joint, made by turning the pipe at the top of trench to meet the welder's convenience, is quickest and most economical.

The *stationery*, made when the pipe cannot be turned, and the *ditch* (see illustration) when the pipe must be welded at bottom of trench, are also economical and quickly made joints.

Further information on pipe welding furnished upon request.

Airco Oxygen and Acetylene Service is Good Service.



AIRCO
PRODUCTS
OXYGEN
ACETYLENE
WELDING AND CUTTING
APPARATUS AND SUPPLIES
ACETYLENE GENERATORS
CARBIDE
NITROGEN

AIR REDUCTION COMPANY, INC.
NEW YORK

AIRCO SERVICE—A DISTRIBUTING STATION NEAR EVERY AIRCO USER

Superior Service

STANDARDIZED

The name "Commercial" has been associated with dissolved acetylene since the beginning of the oxy-acetylene industry. Commercial acetylene is pure and uniform; it is a thoroughly reliable gas. The Commercial proposition is recommended for its simplicity and convenience—you buy the gas and we loan you the cylinders.

Put your welding and cutting problems in the hands of Commercial engineers. There is a Commercial office near you—write to it for full information.

Commercial Acetylene Supply Co.

Main Office 80 Broadway, New York City.

208 S. La Salle St. Chicago.

Atlanta Ga.
East Deerfield Mass.
Moberly Mo.

Aurora Ill.
Toronto Ont.
W. Berkeley Calif.

Boston Mass.
Bound Brook N.J.
San Francisco Cal.